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Investigation Work Plan for Middle Cañada del Buey Aggregate Area

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Prepared by the Environmental Programs Directorate

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Responsible project leader:

Printed Name	Signature	Title	Organization	Date
David McInroy	for	Deputy Program Director	Environmental Programs	10/25/07

Responsible LANS representative:

Printed Name	Signature	Title	Organization	Date
Susan G. Stiger		Associate Director	Environmental Programs	10/28/07

Responsible DOE representative:

Printed Name	Signature	Title	Organization	Date
David R. Gregory		Project Director	DOE-LASO	10/31/07

EXECUTIVE SUMMARY

The Middle Cañada del Buey Aggregate Area, located in the central portion of Cañada del Buey and Mesita del Buey, incorporates parts of Technical Area (TA) 51 and TA-54 at Los Alamos National Laboratory and includes 23 solid waste management units and areas of concern. Previous investigations and analytical results for four sites are discussed in the historical investigation report, the companion document to this work plan. Of the 23 sites, 11 approved for no further action, 4 are Resource Conservation and Recovery Act-permitted storage units, 1 is a Toxic Substances Control Act-permitted storage unit, 1 (Material Disposal Area [MDA] J) was closed under New Mexico Environment Department solid waste regulations, and 2 (MDAs H and L) were investigated under separate work plans; none of these sites are discussed in this work plan. For the remaining four sites, this work plan describes the operational history, evaluates existing analytical data, and proposes characterization activities. Of the four AOCs in the Middle Cañada del Buey Aggregate Area requiring additional characterization, one is located within TA-51 and three are located within TA-54. These sites include two former septic systems and two former high explosives storage magazines.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by Los Alamos National Security, LLC. The Laboratory is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft. The location of the Middle Cañada del Buey Aggregate Area with respect to the Laboratory technical areas (TAs) and surrounding land holdings is shown in Figure 1.0-1. Sites within the aggregate area are shown in Figure 1.0-2.

The Laboratory's Environmental Programs (EP) Directorate (which includes the former Environmental Restoration [ER] Project) is participating in a national effort by DOE to clean up sites and facilities formerly involved in weapons research and development. The goal of the EP Directorate is to ensure that past operations do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, the EP Directorate is investigating and, as necessary, remediating sites potentially contaminated by past Laboratory operations. The sites under investigation are designated as either solid waste management units (SWMUs) or areas of concern (AOCs).

The SWMUs and AOCs addressed in this investigation work plan are potentially contaminated with both hazardous and radioactive components. The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act (HWA), regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 5400.5, "Radiation Protection of the Public and the Environment," and DOE Order 435.1, "Radioactive Waste Management." Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with DOE policy.

Corrective actions at the Laboratory are subject to the March 1, 2005, Compliance Order on Consent (the Consent Order), issued pursuant to the New Mexico HWA, New Mexico Statutes Annotated (NMSA) 1978, § 74-7-10, and the New Mexico Solid Waste Act, NMSA 1978, § 74-9-36(D). This work plan describes activities that will be executed and completed in accordance with the Consent Order.

1.1 General Site Information

Middle Cañada del Buey Aggregate Area is located in the central portion of Cañada del Buey and Mesita del Buey and incorporates parts of TA-51 and -54. The aggregate area consists of the canyon bottom and the portion of the mesa top and canyon slope that drains to the north into the canyon. All SWMUs and AOCs within the Middle Cañada del Buey Aggregate Area are located on the mesa top. Mesita del Buey is a finger-shaped mesa between Pajarito Canyon and Cañada del Buey that trends southeast. The southern boundary of the aggregate area along Mesita del Buey is approximated by Pajarito Road from the west boundary of the aggregate area to the intersection of Pajarito Road and Mesita del Buey Road east of this intersection.

Middle Cañada del Buey Aggregate Area consists of 23 SWMUs and AOCs (also referred to as sites). The sites are categorized on the basis of their regulatory status as follows.

- Four sites will be investigated as part of this investigation work plan.
- Eleven sites have previously been approved for no further action (NFA) by NMED or the U.S. Environmental Protection Agency (EPA) and do not require additional investigation.

- Five sites are active waste management units regulated under the Resource Conservation and Recovery Act (RCRA) or Toxic Substances Control Act (TSCA). These sites will be closed in accordance with RCRA and/or TSCA requirements and will not be investigated under the Consent Order).
- Three sites have been addressed by other investigations or other regulatory programs and do not require further investigation under this work plan.

The SWMUs and AOCs in Middle Cañada del Buey Aggregate Area and their status are presented in Table 1.1-1.

1.2 Investigation Objectives

AOCs 18-005(b) and 18-005(c) have not been investigated previously. AOCs 51-001 and 54-007(d) were investigated previously and remediated. The investigation objective for these sites is to determine the nature and extent of any releases from these sites.

To accomplish this objective, this work plan

- presents historical and background information on the sites;
- describes the rationale for proposed data collection activities; and
- identifies and proposes appropriate methods and protocols for collecting, analyzing, and evaluating data to finalize characterization at these sites.

2.0 BACKGROUND

This section presents background information related to Middle Cañada del Buey Aggregate Area. This information includes the operational history of the TAs, land use, relationships to other SWMUs and AOCs, potential contaminant transport and receptors, waste inventories, and summaries of the results of previous investigations.

2.1 Site Description and Operational History

Middle Cañada del Buey Aggregate Area encompasses portions of TA-51 and -54. Information on the operational history of these TAs is provided below.

2.1.1 TA-51

The first operations in the current TA-51 began in 1980 with construction of the Experimental Engineering Test Facility (EETF). This facility was constructed to support research to develop effective isolation techniques for burial of waste in semiarid climates. Experimental facilities include buried caissons used to conduct flow and transport studies [AOCs 51-002(a) and 51-002(b)]. Support offices were constructed on site in 1986. TA-51 is currently used for research and experimental studies on the long-term impacts of radioactive materials on the environment, including waste isolation barriers (LANL 1992, 007669, pp. 2-1–2-4).

AOC 51-001 at TA-51 was an inactive/abandoned septic system that served the EETF (buildings 51-11 and 51-12) and the transportable offices for buildings 51-25, 51-26, and 51-27 (Figure 2.1-1). The septic

system consisted of a 1000-gal. concrete septic tank (structure 51-30), drainlines, and a 4-ft-wide by 50-ft-deep seepage pit (structure 51-31).

AOC 51-002(a) (structure 51-38) and AOC 51-002(b) (structure 51-39) are environmental research caissons (Figure 1.0-2). Each structure consists of seven 10-ft by 20-ft-long and six 18-in. by 20-ft-long vertical caissons arranged in a circular array. The caissons were filled with earthen materials and used to measure the flow rate of water and chemical tracers. Tracers consisted of common anions and cations (LANL 1992, 007669, pp. 6-9–6-11).

AOC C-51-001 consists of an area used to store drums of soil used in the research caissons. The drums contained only clean soil, and no hazardous materials were present (LANL 1992, 007669, pp. 6-9–6-11).

AOC C-51-002 consists of two former explosives magazines. These sites were previously identified as AOC 18-005(b) and AOC 18-005(c) (Figure 2.1-2).

2.1.2 TA-54

During the 1950s, the Laboratory, with the approval of the U.S. Atomic Energy Commission and upon the recommendation of the U.S. Geological Survey, selected Mesita del Buey within TA-54 for underground disposal of Laboratory-derived waste (Rogers 1977, 005707; Rogers 1977, 005708). Since then, the main waste storage and disposal facilities for the Laboratory have been located in TA-54. TA-54 operations located within Middle Cañada del Buey Aggregate Area are TA-54 West, Material Disposal Areas (MDAs) H and J and Area L.

SWMU 54-001(a) is a 40-ft by 150-ft bermed container storage area located on the paved surface of Area L at TA-54. This storage pad is covered by a fabric dome building (structure 54-215). This container storage unit is currently included in the Laboratory's Hazardous Waste Facility Permit (HWFP) for storing hazardous wastes, and it also operates in accordance with RCRA interim status requirements for storing mixed wastes.

AOC 54-001(b) is a container storage area located inside Building 54-31 in Area L at TA-54. Building 54-31 is 13.5 ft by 14.5 ft with a paved floor that is sealed and bermed. This container storage unit is currently included in the Laboratory's HWFP for storing hazardous wastes.

SWMU 54-001(c) was a portable, inflatable temporary berm containing a steel tank that was originally proposed for the storage of waste oil and hazardous materials at MDA L. However, the tank collected only rainwater, and it was never used to store waste oil or hazardous materials.

AOC 54-001(d) consists of an enclosed polychlorinated biphenyl (PCB)-contaminated waste storage building (building 54-39) and a PCB-contaminated waste storage pad (structure 54-81) that are located on the paved surface of Area L at TA-54. Building 54-39 has a bermed concrete floor on which wastes are stored. Structure 54-81 is 17 ft by 59 ft and is constructed of bermed, sealed concrete. Presently, these storage areas are approved by EPA for storing PCB wastes under TSCA.

AOC 54-001(e) is a container storage area (structure 54-32) located on the paved surface of Area L at TA-54. The storage area consists of a 15.5-ft by 116.5-ft bermed, sealed concrete pad divided into six cells, each with secondary containment. The pad is covered with a 26 ft by 118 ft canopy. This container storage unit is currently included in the Laboratory's HWFP for storing hazardous wastes.

AOC 54-002 is a container storage area (structure 54-216) located on the paved surface of Area L at TA-54. The area is used to store compressed gas cylinders and is located within a fabric-dome building.

This container storage unit is currently included in the Laboratory's HWFP for storing hazardous wastes, and it also operates in accordance with RCRA interim status requirements for storing mixed wastes.

MDA H (SWMU 54-004) was used to dispose of classified wastes from May 1960 to August 1986. MDA H consists of nine disposal shafts that are 6 ft in diameter and 60 ft deep. Wastes disposed of at MDA H included weapon-component mockup shapes, detonators, papers, and tritium-contaminated items. Eight of the shafts are capped with 3 ft of crushed tuff, followed by 3 ft of concrete, and the remaining shaft is capped with 6 ft of concrete. The Laboratory conducted a RCRA facility investigation (RFI) at MDA H (LANL 2001, 070158; LANL 2002, 073270) that NMED approved in 2003 (NMED 2003, 075939). The Laboratory conducted a corrective measures study to evaluate potential corrective measures for this site (LANL 2005, 089332). NMED is currently in the process of selecting a corrective measure for MDA H.

MDA J (SWMU 54-005) is a closed 5.5-acre facility consisting of six pits and four shafts. The site was opened in 1961. Waste disposed of in the pits at MDA J consisted of treated barium sand and administratively controlled waste. Surface sites at MDA J previously included a small land-farming project for aerating soil contaminated with petroleum products, a transfer facility for containers of asbestos awaiting transport to a licensed off-site facility, and two container storage areas. All pits and shafts at MDA J are covered with crushed tuff. MDA J is subject to regulation as a solid waste disposal facility under the New Mexico Solid Waste Regulations. MDA J was closed in accordance with the Solid Waste Regulations in 2002 and a Closure Certification Report was submitted to NMED in October 2002. NMED approved the closure/postclosure care plan in October 2003 (NMED 2003, 098535). Currently, MDA J is undergoing postclosure monitoring.

Area L is the location of active RCRA-permitted hazardous waste storage operations and is also the location of inactive subsurface chemical waste disposal (MDA L, SWMU 54-006). The disposal of chemical wastes at MDA L began in the late 1950s and continued until 1985. Liquid chemical wastes were disposed of in 1 pit, 3 surface impoundments, and 34 shafts. After these subsurface units ceased to be used, the surface of Area L was paved and has been used for storing hazardous and mixed wastes. Area L is permitted under the Laboratory's HWFP for storing hazardous waste, and mixed wastes are stored at the site in accordance with RCRA interim status requirements. The Laboratory conducted an RFI at MDA L and recently completed investigations at MDA L in accordance with Consent Order requirements. The investigation report for MDA L (LANL 2005, 092591; LANL 2006, 091888) was approved by NMED (2007, 098409), and the Laboratory is currently conducting a corrective measures evaluation.

2.1.3 TA-54 West

The western part of TA-54 on Mesita del Buey associated with Middle Cañada del Buey Aggregate Area houses the former radiation exposure facility that was used to conduct biomedical research on animal exposure to radiation. This facility was operated from 1962 to the mid-1970s. A holding facility was used to house animals used in biomedical research until the late 1980s. TA-54 West is now used to conduct waste characterization and packaging operations associated with shipment of transuranic wastes from the Laboratory to the Waste Isolation Pilot Plant in Carlsbad, New Mexico (LANL 1992, 007669). The first structures located at this site were constructed in 1944 and 1945 and consisted of two explosives magazines [AOCs 18-005(b) and 18-005(c)], an assembly building (AOC C-18-002), a carpenter shop, and a lumber storage building. These structures were associated with explosives testing performed at TA-18 and -27 in the mid-1940s. By the early 1960s, these structures had been removed or destroyed (LANL 1993, 015310, p. 2-4) and the site was part of TA-54 (LANL 1993, 015310). The 1990 SWMU report incorrectly lists the two former explosives magazines as being located within TA-51 (LANL 1990, 007512).

AOC 18-005(b) (structure 18-11) and AOC 18-005(c) (structure 18-12) were both wooden structures with dimensions of 11 ft by 9 ft by 8 ft tall (Figure 2.1-2). These structures were surrounded by earthen berms on three sides and on top. AOC 18-005(b) was located approximately 200 ft north of current structure 54-1014. AOC 18-005(c) was located approximately 200 ft north of a Laboratory water-supply storage tank (54-1006) (LANL 1990, 007512).

AOC C-18-002 (structure TA-18-10) was used to assemble explosive devices tested at either TA-18 or -27. Material handled inside the building may have included high explosives (HE), uranium, and thorium. In 1947 or 1948, this building was moved to TA-05 (LANL 1993, 015310, p. 6-1).

SWMU 54-007(c) is a former septic system that served an office building (building 54-34) and the Radioassay and Nondestructive Testing (RANT) Facility (building 54-38) at TA-54 West. The septic system consisted of a 972-gal. concrete septic tank (structure 54-1016 [formerly structure 54-4]), drainlines, a distribution box, and a split drainfield. A 4-in. drainline from the septic tank connected to a reinforced concrete distribution box that diverted effluent east and west into the drainfield. The drainfield consists of two 60-ft-long, 4-in.-diameter tile drainlines that run east and west from the former location of the distribution box. In 1993, the buildings served by this septic system were tied into the Laboratory's Sanitary Wastewater System Consolidation (SWSC), but the septic system was left in place. During a 2000–2001 voluntary corrective action (VCA), the septic tank was removed.

AOC 54-007(d) was an inactive/abandoned septic system that served the Radiation Exposure Facility located in buildings 54-1001, 54-1002, 54-1003, and 54-1004 at TA-54 West (Figure 2.1-3). The septic system consisted of a 1500-gal. concrete septic tank (structure 54-1016 [formerly structure 54-4]), drainlines, a distribution box, and a split drain field. A 4-in. drainline from the septic tank connected to a reinforced concrete distribution box, which diverted the effluent east and west into the drain field. The drain field consists of two 60-ft-long, 4-in.-diameter tile drainlines running east and west from the distribution box.

AOC 54-007(e) is a former septic system that served an animal-holding facility (building 54-1015) at TA-54 West from the time of construction in the mid-1960s until the late 1980s. In 1992, the facility was remodeled as an analytical laboratory for environmental samples. The septic system consisted of a 1500-gal. concrete septic tank (structure 54-9) and a 4-in. polyvinyl chloride (PVC) drainline connected to a drainfield formed by two parallel lines of 4-in. slotted PVC pipe. The two septic system drain fields were interconnected. The septic system was left in place in 1992 when the building it served was tied to a new sewer line installed as part of the Laboratory's SWSC. During a 2000–2001 VCA, the septic tank was removed.

SWMU 54-013(a) was an area designated for a truck-washing pit at TA-54 West. Plans to build the facility were subsequently canceled, and it was never constructed (LANL 1992, 007669, p. 6-13).

SWMU 54-015(h) is a former drum storage area located inside building 54-38, the Nondestructive Testing (NDT) Facility at TA-54 West. No releases of material to this site occurred (LANL 1992, 007669, p. 6-13).

AOC 54-016(a) is a sump used to collect snowmelt and rainwater that is located in the NDT Facility inside building 54-38 at TA-54 West. No releases of hazardous or radioactive materials to this sump occurred (LANL 1992, 007669, p. 6-13).

2.2 Land Use

The SWMUs and AOCs in the Middle Cañada del Buey Aggregate Area are located within TA-51 and -54. Land use at both TA-51 and -54 is industrial. TA-51 is the location of research facilities, and TA-54 is

currently the primary site for waste-management activities. The Laboratory does not anticipate the land use at TA-51 and -54 will change in the reasonably foreseeable future. Public access to both sites is controlled by restricted entry onto Pajarito Road. Access to TA-54 waste management areas is further controlled by fencing and locked gates.

2.3 Relationship to Other SWMUs and AOCs

To develop an approach for investigation of the SWMUs and AOCs in Middle Cañada del Buey Aggregate Area, it is important to understand, at least qualitatively, the potential impact of nearby SWMUs and AOCs on the area. In terms of contaminant inventory and physical size, the most significant SWMUs/AOCs near Middle Cañada del Buey Aggregate Area are those comprising MDA G, which is located near the eastern end of Mesita del Buey, in Lower Pajarito Canyon Aggregate Area, approximately 1 mi east of MDA L. From 1959 to 1997, MDA G was the Laboratory's primary radioactive waste disposal facility. MDA G is located in Area G, which occupies 63 acres and is the current low-level-waste-disposal area scheduled to operate through 2044. Investigations to date have revealed a subsurface contamination consisting of vapor-phase volatile organic compounds (VOCs) and tritium in subsurface pore water (LANL 2005, 090513). These contaminants are similar to those known to have been released from MDA L, and available data do not indicate migration of subsurface contaminants from MDA G to MDA L (LANL 2005, 092591; LANL 2006, 091888). Surface contamination in Area G runs off to either Cañada del Buey or Pajarito Canyon downstream of Middle Cañada del Buey Aggregate Area and does not impact the aggregate area.

To the west, the nearest SWMUs and AOCs are located in TA-46, on Mesita del Buey, in Upper Cañada del Buey Aggregate Area, less than 1 mi northwest of TA-51. Releases from SWMUs and AOCs in TA-46 do not impact Middle Cañada del Buey Aggregate Area because of the distance between these sites. Although TA-46 is topographically higher than Middle Cañada del Buey Aggregate Area, runoff from TA-46 flows into Cañada del Buey rather than along the mesa top.

No SWMUs or AOCs are in close proximity to AOC 51-001. AOC 54-007(d) is located approximately 400 ft northwest of AOCs 18-005(b) and 18-005(c) but is not associated with these AOCs. AOCs 18-005(b) and 18-005(c) are located approximately 160 ft apart and both were HE storage magazines. No other SWMUs or AOCs not previously approved for NFA are in close proximity to, or associated with, AOCs 18-005(b), 18-005(c), and 54-007(d).

2.4 Contaminant Transport and Potential Receptors

The inventory of hazardous constituents present at SWMUs and AOCs within Middle Cañada del Buey Aggregate Area includes inorganic chemicals, organic chemicals, and radionuclides. The relevant release and transport processes associated with these materials are a function of chemical-specific properties, physical form, and the nature of the transport process. The transport of VOCs, for example, occurs primarily in the gas phase and by diffusion or advection in air. Relatively water-soluble contaminants are susceptible to release and transport through water infiltration.

The primary potential release and transport mechanisms for contaminants at the sites in Middle Cañada del Buey Aggregate Area being investigated under this work plan include the following.

Volatilization, diffusion, and dispersion in air. Low concentrations of VOCs were detected in subsurface samples at AOCs 51-001 and 54-007(d). Gas or vapor-phase contaminants diffuse from contaminated media diffuse through the air-filled pores in the subsurface rock. Migration of gas or vapor-phase

contaminants from the tuff into ambient air may occur by diffusion or by advection driven by changes in barometric pressure.

Dissolution and advective transport in water. Inorganic and organic chemicals were detected in subsurface samples at AOCs 51-001 and 54-007(d) and may be present in soil at AOCs 18-005(b) and 18-005(c). Infiltrating precipitation may dissolve contaminants and slowly transport them through the subsurface rock. Transport in tuff may be facilitated by the presence of fractures, especially when they have coatings with low conductivity or when sufficient liquid saturates the matrix adjacent to the fracture where a flow is occurring.

Erosion and transport in surface water. Inorganic and organic chemicals may be present in surface soils at AOCs 18-005(b) and 18-005(c). Contaminated soil particles may be eroded by stormwater and transported by surface runoff into Cañada del Buey. Contaminated sediments in the canyon can then be transported farther downstream by ephemeral surface water flow.

Wind erosion and dispersion. Inorganic and organic chemicals may be present in surface soils at AOCs 18-005(b) and 18-005(c). Contaminated soil particles may be eroded by wind and transported downwind.

Potential receptors include Laboratory workers in TA-51 and 54, who could potentially be exposed to contaminants in soil by direct contact, ingestion, or inhalation. Ecological receptors may also be exposed to soil contaminants. Industrial workers and ecological receptors could also be exposed to contaminated sediments in Cañada del Buey. The canyon is not accessible for recreational use and exposure of recreational users is not expected. Because of the low infiltration rate on Mesita del Buey, transport to groundwater is not likely, and exposure by ingestion of groundwater is not expected.

2.5 Waste Inventory

The four AOCs to be investigated under this work plan have small waste inventories. AOCs 18-005(b) and 18-005(c) consist of former explosives magazines that were destroyed by burning. The inventory for these sites is expected to be limited to residue remaining from combustion of the structures.
AOCs 51-001 and 54-007(c) consist of former septic systems. Both AOCs underwent VCAs to remove the septic tanks and plug drainlines, and any remaining inventory is expected be limited to contaminants discharged to the subsurface.

2.6 Summary of Historical Investigations

2.6.1 AOC 18-005(b), Former Storage Area

AOC 18-005(b) has not been investigated previously.

2.6.2 AOC 18-005(c), Former Storage Area

AOC 18-005(c) has not been investigated previously.

2.6.3 AOC 51-001, Former Septic System

The septic tank contents and seepage pit were sampled during the 1995 Phase I RFI (LANL 1992, 007669). Sampling locations are shown in Figure 2.6-1. The analytical suite for the sludge and tuff samples included pesticides/polychlorinated biphenyls (PCBs), cyanide, VOCs, semivolatile organic compounds (SVOCs), and target analyte list (TAL) metals (Table 2.6-1). Inorganic chemicals detected above the background value (BV) or having detection limits above BV are shown in Table 2.6-2 and

Figure 2.6-2. Lead was detected above BV but was eliminated as a chemical of potential concern (COPC) because the detected concentration was within the range of the background data set. Antimony, cyanide, mercury, selenium, and silver were not detected but were retained as COPCs because their detection limits were greater than BVs in tuff. No organic chemicals were detected. Waste characterization data for samples collected from the septic tank contents in 2000 showed low concentrations of inorganic chemicals, isotopes of uranium and plutonium, tritium, nitrate, and three organic chemicals (LANL 2001, 071473).

In 2001, a VCA to remove the septic system was conducted at AOC 51-001 and involved removing the septic tank contents and the septic tank and plugging the drainlines. Confirmation samples were collected from six locations within the septic tank excavation, beneath the inlet drainline connection, and adjacent to the seepage pit. The analytical suites for the VCA confirmation samples included isotopic plutonium, isotopic uranium, gamma-emitting radionuclides, tritium, strontium-90, pH, VOCs, and SVOCs (LANL 2000, 070658). In accordance with the approved VCA plan, confirmation samples were not analyzed for inorganic chemicals because they were not detected above BVs in the 1995 RFI samples (LANL 2000, 070658). Organic chemicals detected in these samples are presented in Table 2.6-3 and Figure 2.6-3. Two VOCs (2-butanone and trichlorofluoromethane) were detected at low concentrations at two locations below EQLs. Bromomethane was detected at a concentration below the estimated quantitation limit (EQL) in the deepest sample collected at location 51-10001. No SVOCs, pesticides or PCBs were detected. All VCA confirmation samples from AOC 51-001 were analyzed by gamma spectroscopy and for isotopic plutonium, isotopic uranium, tritium, and strontium-90. Cesium-137 was detected in one fill sample at 0.0761 pCi/g at location 51-0002 at a depth of 5.5 to 6.5 ft bgs. This concentration is below the soil fallout value (FV) of 1.65 pCi/g.

2.6.4 AOC 54-007(d), Former Septic System

The septic system was investigated during the 1995 Phase I RFI (LANL 1992, 007669). Phase I RFI data were summarized in the VCA plan (LANL 2000, 070658). As part of the RFI, the contents of the septic tank were sampled and analyzed. At that time, between 3 and 3.5 ft of liquid and sludge remained in the tank. Waste characterization data for samples collected from the septic tank contents in 2000 showed low concentrations of inorganic chemicals, organic chemicals, nitrate, and isotopes of uranium (LANL 2001, 071473).

A VCA was conducted at AOC 54-007(d) in 2001 to remove the septic tank contents and the septic tank and plug the drainlines. Confirmation samples were collected from six locations within the septic tank excavation, beneath the inlet drainline connection, and from the drain field (Figure 2.6-4). The analytical suites for each sample are provided in Table 2.6-4 and included VOCs and SVOCs. Organic chemicals detected in drain field samples are presented in Table 2.6-5 and Figure 2.6-5. Detected organic chemicals are benzene, bis(2-ethylhexyl) phthalate; bromomethane; 2-butanone; isopropylbenzene; 4-isopropyltoluene; 4-methyl-2-pentanone; toluene; trichlorofluoromethane; and trimethylbenzene[1,2,4-]. These organic chemicals were detected at concentrations less than or slightly above their respective EQLs in one or more samples. None of these organic chemicals were detected in the contents of the septic tank (LANL 2001, 071473). At most locations, the concentrations of organic chemicals decreased slightly with depth or remained unchanged (Table 2.6-5 and Figure 2.6-5).

3.0 SITE CONDITIONS

This section discusses aspects of the environmental setting within Middle Cañada del Buey Aggregate Area important to assessing the potential impacts of contaminated surface and subsurface media, including

- the semiarid climate with low precipitation and a high evapotranspiration rate, which limits the amount of moisture percolating into wastes or areas of contamination and thus limits the amount of moisture available to leach radionuclides or hazardous waste constituents;
- the thick, relatively dry unsaturated zone, which greatly restricts or prevents downward migration of contaminants in the liquid phase through the vadose zone to the regional aquifer; and
- the canyon-mesa terrain, which affects atmospheric conditions and ecological habitats.

3.1 Surface Conditions

Middle Cañada del Buey Aggregate Area is located in the central portion of Cañada del Buey and Mesita del Buey and incorporates parts of TA-51 and -54. The aggregate area consists of the canyon bottom and that portion of the mesa top and canyon slope that drain to the north into the canyon. All SWMUs and AOCs within the Middle Cañada del Buey Aggregate Area are located on the mesa top. Mesita del Buey is a finger-shaped mesa between Pajarito Canyon and Cañada del Buey that trends southeast. The southern boundary of the aggregate area along Mesita del Buey is approximated by Pajarito Road from the west boundary of the aggregate area to the intersection of Pajarito Road, and by Mesita del Buey Road to the east of this intersection. The width of the mesa top within the aggregate area ranges from approximately 150 ft to the west of Area L in TA-54 to approximately 1200 ft at TA-51. The elevation of Mesita del Buey within the aggregate area ranges from approximately 6740 to 7050 ft. The topography on the mesa top slopes gently from west to northeast, gradually steepening in the northeast towards Cañada del Buey. The elevation of the canyon bottom ranges from approximately 6740 ft at the east end of the aggregate area to 6870 ft at the west end. The developed portions of the aggregate area are covered with buildings and asphalt, and the remainder is covered with native vegetation.

3.1.1 Soil

The soil of Mesita del Buey is derived from the weathering of the Tshirege Member tuff (phenocrysts and phenocryst fragments, devitrified glass, and minor lithic fragments) and from wind-blown sources. Soil on the flanks of the mesa is developed on Tshirege Member tuff and colluvium with additions from wind-blown and water-transported sources. Native soil has been disturbed by Laboratory operations over much of the surface of Mesita del Buey within TA-51 and -54. When present, native soil is generally thickest near the center of the mesa and thinner toward the edges.

In general, soil on the mesa surface is thin and poorly developed; it tends to be sandy near the surface and more clay-like beneath the surface. More highly developed soil profiles exist on the north-facing slopes; it tends to be richer in organic matter. Soil profiles on the south-facing slopes tend to be poorly developed. Soil-forming processes have been identified along fractures in the upper part of the mesa, and the translocation of clay minerals from surface soil into fractures has been described at Mesita del Buey. A discussion of soil in the Los Alamos area can be found in the approved ER Project installation work plan (LANL 1998, 062060, pp. 2-6–2-21)

Soil on Mesita del Buey is poorly developed, as is typical of soil derived from Bandelier Tuff and formed under semiarid climate conditions (Nyhan et al. 1978, 005702). In general, undisturbed soil on the mesa

tops consists of the Carjo loam, the Hackroy loam, and the Seaby loam. Canyon bottoms are covered with colluvium and alluvium that has eroded from the tuff and soil on the mesa top and canyon walls. The canyon rims and slopes are composed of soil from the Hackroy-Rock outcrop complex; the canyon bottoms are composed of the Tocal, a very fine, sandy loam. Since Laboratory operations began on Mesita del Buey, Cañada del Buey has experienced a period of accretion, and eroded soil from the mesa top has been deposited on the canyon bottom and stream banks. Potentially, this soil may be redistributed downstream during storm runoff events (LANL 2004, 087624, p. 16).

3.1.2 Surface Water

No streams flow on Mesita del Buey; water flows only as stormwater and snowmelt runoff on the mesa and in small drainages off the mesa to the north and the south. As a result of runoff, surface erosion occurs primarily as shallow sheet erosion on the relatively flat parts of the mesa and as channel erosion in major drainages from the mesa top. Runoff from summer storms reaches a maximum in less than 2 h and lasts less than 24 h. By contrast, runoff from spring snowmelt occurs over a period of several weeks at a low discharge rate. The amount of eroded material transported in waters is generally higher during summer rainfall events than during snowmelt (Hollis et al. 1997, 063131, pp. 2–33).

The primary source of water in Cañada del Buey is runoff from the surrounding mesa tops. The amount of runoff is insufficient to support continuous flow in any part of the canyon and Cañada del Buey is entirely ephemeral on Laboratory property (LANL 1999, 064617, p. 3-103). Water in the stream channel may be present for short periods during runoff from summer thundershowers.

Stream flow in Cañada del Buey has been monitored by several gauging stations installed in the canyon. None of the gauging stations is located within the aggregate area. Station E218, installed in 1997, is located approximately 2600 ft upstream of the aggregate area boundary, and Station E225, installed in 1993, is located approximately 1100 ft downstream of the aggregate area boundary. These gauging stations rarely show flow. Station E218 measured flow on 20 d for a period of record from October 2002 to September 2003. Station E225 measured flow on 2 d for the same period of record (Shaull et al. 2004, 093737, pp. 46, 48).

3.2 Subsurface Conditions

3.2.1 Stratigraphy

The stratigraphy at Middle Cañada del Buey Aggregate Area has been characterized by investigations conducted at MDAs H and L and the installation of regional wells around TA-54. The stratigraphy beneath Mesita del Buey includes the Bandelier Tuff and the Cerros del Rio basalt. The regional aquifer is primarily in the Santa Fe Group, Puye Formation, and Cerros del Rio basalts.

Bandelier Tuff

With reference to the Bandelier Tuff, the term *welding* is used to distinguish between tuffs that are uncompacted and porous (nonwelded) and those that are more compacted and dense (welded). In the field, the degree of welding in tuff is quantified by the degree of flattening of pumice fragments (a higher degree of flattening and elongation equals a higher degree of welding). Petrographically, welded tuffs show adhesion (welding) of grains, but nonwelded tuffs do not. The term *devitrified* is applied to tuff whose volcanic glass has crystallized. Figure 3.2-1 shows the generalized stratigraphy of the Bandelier Tuff.

Tshirege Member

The Tshirege Member of the Bandelier Tuff is a compound-cooling unit that resulted from several successive ash-flow deposits separated by periods of inactivity, which allowed for partial cooling of each unit. Properties related to water flow and contaminant migration (e.g., density, porosity, degree of welding, fracture content, and mineralogy) vary both vertically and laterally as a result of localized emplacement temperature, thickness, gas content, and composition.

Tshirege Member Unit 2

Unit 2 of the Tshirege Member of the Bandelier Tuff (Qbt 2) is a competent, resistant unit that forms the surface of Mesita del Buey. Its thickness varies from 35 ft (10.7 m) to 40 ft (12.2 m) at MDA L (LANL 2004, 087624, Appendix F). Where it is exposed, unit 2 forms nearly vertical cliffs on the sides of the mesa. The rock is described as a moderately welded ash-flow tuff composed of crystal-rich, devitrified pumice fragments in a matrix of ash, shards, and phenocrysts (primarily potassium feldspar [sanidine] and quartz).

Unit 2 is extensively fractured as a result of contraction during postdepositional cooling. The cooling-joint fractures are visible on mesa edges and on the walls of pits. In general, the fractures dissipate at the bottom of unit 2. On average, fractures in unit 2 are nearly vertical. The mean spacing between fractures ranges between 1.9 ft and 2.6 ft (0.6 m and 8.8 m), and the fracture width ranges between less than 0.03 in. and 0.51 in. (1 mm and 13 mm), with a median width of 0.12 in. (3 mm). The fractures are typically filled with clays to a depth of about 9.9 ft (3 m); smectites are the dominant clay minerals present. Smectites are known for their tendency to swell when water is present and for their ability to strongly bind certain elements. Opal and calcite can be found throughout the fractured length, usually in the presence of tree and plant roots (live and decomposed); the presence of both the minerals and the roots indicates some water at depth in fractures. At the base of unit 2 is a series of thin, less than 3.9-in.-thick (10-cm-thick), discontinuous, crystal-rich, fine- to coarse-grained surge deposits. Bedding structures are often observed in these deposits. The surge beds mark the base of unit 2 (LANL 2004, 087624).

Tshirege Member Unit 1v

Tshirege Member unit 1v (Qbt 1v) is a vapor-phase-altered cooling unit underlying unit 2. This unit forms sloping outcrops, which contrast with the near-vertical cliffs of unit 2. Unit 1v is further subdivided into units 1vu and 1vc.

Unit 1vu. The uppermost portion of unit 1v is devitrified and vapor-phase-altered ash-fall and ash-flow tuff; it has been designated unit 1vu, where *u* signifies upper. Its thickness varies from 60 ft (18.3 m) to 75 ft (22.9 m) at MDA L (LANL 2004, 087624, p. 18). Unit 1vu is unconsolidated at its base and becomes moderately welded nearer the overlying unit 2. Only the more prominent cooling fractures originating in unit 2 continue into the more welded upper section of unit 1vu but die out in the lower, less consolidated section. More typically, fractures in unit 2 do not extend into unit 1vu.

Unit 1vc. Beneath unit 1vu is unit 1vc, where *c* stands for colonnade, named for the columnar jointing visible in cliffs formed from this unit. Unit 1vc is a poorly welded, devitrified ash-flow tuff at its base and top, and becomes more welded in its interior. Unit 1vc is approximately 25 ft (7.6 m) thick at MDA L (LANL 2004, 087624, p. 18).

Tshirege Member Unit 1g

The basal contact of unit 1vc is marked by a rapid change (within 0.7 ft [0.2 m] vertical) from devitrified (crystallized) matrix in unit 1vc to vitric (glassy) matrix in the underlying unit 1g (Qbt 1g). Vitric pumices in unit 1g stand out in relief on weathered outcrops, but devitrified pumices above this interval are weathered out. In outcrop, this devitrification interval forms a prominent erosional recess termed the *vapor-phase notch*. No depositional break is associated with the vapor-phase notch; the abrupt transition indicates this feature is the base of the devitrification that occurred in the hot interior of the cooling ash-flow sheet after emplacement.

Unit 1g is a vitric, pumiceous, nonwelded ash-flow tuff underlying the devitrified unit 1vc. It is about 140 ft (42.7 m) thick at MDA L (LANL 2004, 087624, p. 18). Few fractures are observed in the visible outcrops of this unit, and weathered cliff faces have a distinctive Swiss-cheese appearance because of the softness of the tuff. The uppermost 5 ft to 20 ft (1.5 m to 6.1 m) of unit 1g are iron-stained and slightly welded. This portion of unit 1g is resistant to erosion, helping to preserve the vapor-phase notch in the outcrops. A distinctive pumice-poor surge deposit forms the base of unit 1g.

Tsankawi Pumice Bed

The Tsankawi Pumice Bed is the basal air-fall deposit of the Tshirege Member of the Bandelier Tuff. It is a thin bed of gravel-sized vitric pumice. It is about 3 ft (1 m) thick at MDA L (LANL 2004, 087624, p. 18).

Cerro Toledo Interval

The Cerro Toledo interval consists of thin beds of tuffaceous sandstones, paleosols, siltstones, ash, and pumice falls; it separates the Tshirege and Otowi Members of the Bandelier Tuff. The Cerro Toledo interval also includes localized gravel- and cobble-rich fluvial deposits predominantly derived from intermediate composition lavas eroded from the Jemez Mountains west of the Pajarito Plateau. This interval varies in thickness between 15 ft (4.6 m) to 30 ft (9.1 m) at MDA L (LANL 2004, 087624, p. 18).

Otowi Member

The Otowi Member tuff is about 80 ft (24.4 m) thick at MDA L (LANL 2004, 087624, p. 18). The tuff is a massive, nonwelded, pumice-rich, and mostly vitric ash flow. The pumices are fully inflated, supporting tubular structures that have not collapsed as a result of welding. The matrix is an unsorted mix of glass shards, phenocrysts, perlite clasts, and minute, broken pumice fragments.

The Guaje Pumice Bed is the basal air-fall deposit of the Otowi Member of the Bandelier Tuff. The thickness of the unit has been measured at 10 ft (3.1 m) beneath MDA L (LANL 2004, 087624, p. 18). The pumice bed is nonwelded but brittle. Pumice tubes are partially filled with silica cement.

Cerros del Rio Basalts (Tb 4)

In the vicinity of TA-54, the Cerros del Rio basalts lie directly beneath the Otowi Member of the Bandelier Tuff (LANL 2004, 087624). In well R-32, the basalts are 636 ft (193.9 m) thick; in well R-22, the basalts are 983 ft (299.6 m) thick. In both wells, the regional water table occurs within these basalts (LANL 2004, 087624). Local borehole cores at MDA L show that the basalts consist of both angular rubble and dense, fractured masses, with zones of moderately to very porous lavas (LANL 2004, 087624, p. 18). Deeper drilling at R-22 showed a wide variety of lithologies within the basalts, including massive flows, interflow rubble or scoria zones, sediments, and paleosols (LANL 2004, 087624).

Puye Formation (Tpf, Tpp) and Older Fanglomerate

The Puye Formation is a conglomerate deposit derived primarily from volcanic rocks to the west, with varying lithologies, including stream channel and overbank deposits, ash and pumice beds, debris flows and lahar deposits. Well tests on the plateau confirm that the unit is very heterogeneous with both high and low permeability zones present (Nylander et al. 2003, 076059.49). The formation is poorly lithified, and as such is unlikely to sustain open fractures.

As shown in Figure 3.2-1, the Puye Formation thins from west to east beneath TA-54. At supply well PM-2, the Puye Formation (including fanglomerate, pumiceous units and ancestral Rio Grande deposits) is approximately 800 ft (243.8 m) thick; at well R-23 it is completely absent. Recent drilling across the plateau indicates that the Puye Formation is frequently underlain by alluvial fan deposits similar in lithology to the Puye, but considerably older (LANL 2004, 087624). These deposits are of considerable thickness at supply well PM-2, were penetrated at well R-22 (approximately 80 ft [24.4 m] thick), and were absent at well R-23. The Puye Formation was also encountered at well R-16 (351 ft [106.9 m] thick); the water table occurs within the Puye Formation at this location (LANL 2004, 087624).

Totavi Lentil Deposits (Tpt)

The Totavi Lentil is an ancestral Rio Grande deposit and consists of coarse gravels and sands with abundant quartzite. The deposit has been alternatively conceptualized as a series of distinct north-south trending ribbons as well as a continuous thin sheet at the base of the Puye Formation. Like the overlying Puye Formation, it has both high and low permeability zones (Nylander et al. 2003, 076059.49).

Santa Fe Group (Tsf, Tf, and Ts) and Santa Fe-Age Basalts (Tb 1 and Tb 2)

The Santa Fe Group is an alluvial-fan deposit comprised of medium to fine sands and clays. Numerous north-south trending faults are present in the Santa Fe Group. Santa Fe Group rocks are deep below Pajarito Canyon to the south of Mesita del Buey (1500 ft [457.2 m] below ground surface [bgs] at supply well PM-2) and were not penetrated by wells R-20, R-32, or R-22 (LANL 2004, 087624). Most water supply wells on the eastern edge of the Pajarito Plateau and elsewhere in the basin are completed in these rocks. The Santa Fe Group units are characterized with the lowest permeability compared to the other units in the regional aquifer.

Basaltic lava flows occurred during the time that the Santa Fe Group was deposited; these basalts occur both within the Santa Fe Group and within the pre-Puye sands, gravels, and conglomerates that were penetrated by wells R-20 and R-22. These old basalts appear to have fewer open fractures than the younger Cerros del Rio basalts.

3.2.2 Hydrogeology

The proposed hydrogeologic conceptual model for the Pajarito Plateau (LANL 1998, 059599) is presented in Figure 3.2-2. The model predicts that infiltration of water into the subsurface and subsequent transport of water, vapor, and solutes through the upper regions of the vadose zone is heavily influenced by surface conditions such as topography, surface water flow, and microclimate. According to model predictions, movement through deeper layers, including the regional aquifer, is only weakly influenced by surface conditions and is influenced more by the hydraulic characteristics of aquifer rocks, regional groundwater flow patterns, and stresses induced by water-supply production. The following sections provide an overview of infiltration rates and groundwater occurrences near the Middle Cañada del Buey Aggregate Area.

Infiltration

Surface and near-surface conditions (topography, precipitation, surface runoff) control water infiltration to the subsurface and the transport of contaminants into the shallow subsurface. In this respect, the climate behavior of mesas and canyons forming the plateau differ from one another (LANL 1998, 059599). Mesas are generally dry, both on the surface and within the rock forming the mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional stream flow and may lack alluvial groundwater.

Relatively small volumes of water move beneath mesa tops under natural conditions because of low rainfall, runoff into canyons, high evaporation, and efficient water use by vegetation. Liquid water generally infiltrates the mesa, and water vapor generally moves upward, undergoing evapotranspiration along the top and sides of the mesa. Air circulates through the mesa-top units because of the relatively dry pore spaces and the topographic relief. Air circulation may be driven by temperature variations, barometric pumping, or surface winds. This process promotes atmospheric evaporation, which may extend deep within the mesa and further inhibit the downward liquid-water flow.

Mesita del Buey is one of the drier mesas at the Laboratory and the Pajarito Plateau. Infiltration into the mesa appears to be very low, possibly only 0.04 in./yr (Hollis et al. 1997, 063131, p. 2-51), and occurs during snowmelts or intense summer thunderstorms, which leads to slightly higher moisture content within the uppermost few meters of the mesa surface. During dry periods, evapotranspiration removes moisture from the surface of the mesa; permeable zones such as fractures and surge beds act as conduits for air and aid in drying the mesa.

3.2.3 Groundwater

Groundwater beneath the Laboratory occurs in the regional aquifer (at depths ranging from 600 to 1200 ft bgs) and in perched, intermediate, and shallow aquifers. With the exception of TA-16, perched groundwater has been detected only in wells beneath relatively wet canyons (e.g., Los Alamos Canyon) as (1) shallow alluvial aquifers that occur in some wet canyons (generally at depths less than 100 ft), and (2) deeper “intermediate” perched aquifers that occur in zones separated from both alluvial and regional aquifers by unsaturated rock. To date, data indicate that dry mesas such as Mesita del Buey show no evidence of perched groundwater beneath the mesa. However, alluvial and intermediate perched aquifers in adjacent canyons may cause increased moisture content within the vadose zone at the base of the mesa.

Alluvial/Groundwater

Several shallow monitoring wells have been installed in Cañada del Buey within the Middle Cañada del Buey Aggregate Area. These wells include CdBO-1 and CdBO-2, installed in the south fork of Cañada del Buey downstream from MDA J; CdBO-3, installed in the lower South Fork of Cañada del Buey adjacent to MDA L; and CdBO-6, CdBO-7, CdBO-8, and CdBO-9, installed in the main channel of Middle Cañada del Buey downstream from TA-46 (Figure 3.2-3). After the SWSC treatment plant was constructed at TA-46 in 1992, the latter four wells were installed to monitor alluvial groundwater in the event that effluent from the plant was discharged to a tributary of Cañada del Buey. To date, this effluent has been transferred to TA-03 for reuse or discharge.

Water was not detected in wells CdBO-1, CdBO-2, CdBO-3, CdBO-8, or CdBO-9 during drilling or subsequently. A 10-ft thick perched water zone was encountered at a depth of 34 to 44 ft bgs during drilling of CdBO-6 and this well has yielded enough water for sampling every year since 1992. Similarly, a

1- to 2-ft thick zone of perched water was encountered during drilling of CdBO-7, located approximately 2000 ft downstream from CdBO-6. This well has contained enough water from sampling each year since 1993. Well CdBO-5, which is located approximately 3300 ft upstream of CdBO-6 just north of the Middle Cañada del Buey Aggregate Area boundary also has never contained water. Alluvial groundwater within middle Cañada del Buey appears to extend from approximately the location of CdBO-6 downstream for a distance of at least 2000 ft to CdBO-7, and probably for some distance farther downstream (LANL 1999, 064617, p. 3-116).

The principal source of the alluvial groundwater observed in CdBO-6 and CdBO-7 appears to be municipal supply well PM-4, which is located on a ledge of the south canyon wall adjacent to CdBO-6. When well PM-4 is taken out of service, it must be purged during startup and purge water is discharged through a National Pollutant Discharge Elimination System-permitted outfall into Cañada del Buey at the approximate location of CdBO-6. Other sources may include runoff infiltration from the upper canyon reaches, supplemented by infiltration of local precipitation (LANL 1999, 064617, p. 3-116).

Perched Intermediate Waters

Observations of perched intermediate water are rare on the Pajarito Plateau. Perched intermediate waters are thought to form mainly at horizons where medium properties change dramatically, such as at paleosol horizons containing clay or caliche. It is not known whether perched intermediate water bodies are isolated or connected and to what degree they may influence travel times and pathways for contaminants in the vadose zone. Although perched intermediate groundwater has been observed in some locations on the plateau, none has been observed in the regional wells in the vicinity of Mesita del Buey (wells R-22, R-21, R-20, and R-16) (LANL 1998, 059599).

Perched intermediate groundwater was not encountered, nor is it suspected beneath Mesita del Buey at Middle Cañada del Buey Aggregate Area. No perched groundwater was observed in 660 ft of drilling in the deepest vertical borehole drilled to date at MDA L (LANL 2005, 092591).

Regional Aquifer

The regional aquifer of the Pajarito Plateau is the only aquifer capable of supplying large-scale municipal water (Purtymun 1984, 006513). The regional aquifer extends throughout the Española Basin (an area roughly 2300 mi^2 [6000 km^2]) and reaches its maximum thickness beneath the Pajarito Plateau (over 9800 ft thick [Cordell 1979, 076049]).

Depths to the regional aquifer range between about 1200 ft along the western edge of the plateau and about 600 ft along the eastern edge. Beneath Mesita del Buey within Middle Cañada del Buey Aggregate Area, the water table elevation is approximately 5800 ft. Figure 3.2-4 depicts water-table elevations across the plateau (i.e., a cross-section of hydraulic head data [water-table elevations] collected in the regional aquifer).

Groundwater flow in the regional aquifer between Middle Cañada del Buey Aggregate Area and the Rio Grande (approximately 4 mi) occurs primarily in the Santa Fe Group. Pump tests in individual water-supply wells throughout the plateau indicate that the hydraulic conductivity (K) of the Santa Fe Group along the eastern edge of the plateau is the lowest of any aquifer unit ([average K for Los Alamos well field = 0.7 ft/d]; Purtymun 1995, 045344). More recent analyses of water-level trends over a 55-yr period indicate that these K estimates, although accurate locally, may be higher than the large-scale effective permeability of the Santa Fe Group (0.2 ft/d) because of the flow impedance of north-south trending faults (LANL 2004, 087624). Assuming a porosity of 0.2 (typical of sedimentary rocks [Freeze and Cherry 1979,

088742]) and the measured gradient of 0.02, pore water velocities in this portion of the regional aquifer would be slow (approximately 0.02 to 0.07 m/yr [Nylander et al. 2003, 076059.49, p. 5-2]). This result indicates that travel times within the regional aquifer (Santa Fe Group rocks) from TA-54 to the Rio Grande would be, on an average, over 1000 yr.

Vadose Zone

The region beneath the ground surface and above the regional aquifer is called the vadose (unsaturated) zone. The source of moisture in the vadose zone beneath Mesita del Buey is infiltrating precipitation, but most of the precipitation is removed as runoff or evapotranspiration in the upper region of the vadose zone (Hollis et al. 1997, 063131, p. 2-33). The subsurface movement of the remaining water (often referred to as recharge) is predominantly vertical in direction and is influenced by properties and conditions of the vadose zone. Characteristics of infiltration in the vadose zone are described above (see "Perched Intermediate Waters").

The geologic property of the Bandelier Tuff that most influences the fluid flow in the unsaturated zone is the degree of welding. Welded tuffs tend to have less matrix porosity and more fractures than nonwelded tuffs. Fractures in welded tuff may include relatively close-spaced cooling joints as well as tectonic fractures. Although welded tuffs also have fractures, they are generally less abundant than in welded tuffs.

Several competing effects determine moisture content and fluid flux in welded, devitrified tuff. Although water moves slowly through the unsaturated tuff matrix, it can move relatively rapidly through fractures if saturated or nearly saturated conditions exist (Hollis et al. 1997, 063131). The moisture levels measured at MDA L are relatively low (1% to 13% gravimetric moisture content [Daniel B. Stephens & Associates Inc. 1994, 076071]). At these moisture levels, most of the fractures beneath MDA L are completely dry, and water is found only in the tuff matrix. In situations when substantial infiltration occurs from the ground surface, the fractures become wet and conduct water. However, modeling studies at MDA G to the east of MDA L predict that if fractures disappear at contacts between stratigraphic subunits, if fracture fills are encountered, or if coatings are interrupted, fracture moisture is absorbed into the tuff matrix (Hollis et al. 1997, 063131, p. SD2C-1).

4.0 SCOPE OF ACTIVITIES

Proposed sampling activities to determine the nature and extent of contamination at the four AOCs addressed in this work plan are described in the following sections.

4.1 Proposed Activities for AOCs 18-005(b) and 18-005(c)

The proposed sampling locations at these two sites are shown in Figure 4.1-1. Table 4.1-1 provides a summary of the proposed sampling locations, sampling depths, and analytical suites for each site. Ten samples will be collected from five locations in/around the footprints of each former magazine for a total of 20 samples. Samples will be collected from the 0- to 1.0-ft- and 2.0- to 3.0-ft-depth intervals at each location and analyzed for TAL metals, explosive compounds, cyanide and nitrates. Samples will not be analyzed for radionuclides, moisture, pH, cyanide, nitrates, perchlorate, or organic chemicals since these areas were designated as AOCs solely because of the past presence of explosives.

Samples will be field screened for the explosives TNT (trinitrotoluene-2,4,6) and RDX (research department explosive [also hexahydro-1,3,5-trinitro-1.3.5-triazine]) using immunoassay kits, as described in section 5.2. Field screening will determine whether step-out samples will need to be collected (e.g.,

20 ft laterally to the north, south, east, and west if proposed sampling locations cannot be used to define extent). The step-out samples will be collected from the same depth intervals as their corresponding sampling location until field-screening results indicate no measurable contamination. Samples will also be field screened for radioactivity and VOCs for health and safety monitoring purposes.

4.2 AOC 51-001

The proposed sampling locations for AOC 51-001 are the same locations from the 2001 VCA and one additional location beneath the former outlet connection Figure 4.2-1 to determine nature and extent of potential contaminants not previously analyzed for or that were detected in previous samples Table 4.2-1 provides a summary of the proposed sampling locations, depths, the objectives each sample addresses, and the analytical suites. Sampling at AOC 51-001 will consist of the following activities.

- *Drainlines*. The septic system drainlines were plugged during the 2001 VCA. Samples will be collected from the 0- to 1.0-ft- and 2.0- to 3.0-ft-depth intervals beneath the former inlet and outlet drainline connections to the septic tank. These former septic tank connections are the most likely location for a drainline leak to have occurred. Zero depth is defined as the soil directly beneath the drainlines at a depth of 7.5 ft bgs.
- *Septic Tank*. Samples will be collected from three locations within the septic tank footprint from two depth intervals (10.5 to 11.5 ft bgs and 12.5 to 13.5 ft bgs) at each location.
- *Seepage Pit*. Four samples will be collected from two boreholes adjacent to the seepage pit from depth intervals of 49 to 50 ft bgs and 59 to 60 ft bgs (Figure 4.2-1).

Samples will be analyzed at off-site fixed laboratories for VOCs, SVOCs, TAL metals, cyanide, nitrate, isotopic plutonium, tritium, and isotopic uranium. Pesticides, gamma spectroscopy, and strontium-90 will not be analyzed because they were not detected in the septic tank contents or VCA confirmation samples (Tables 2.6-2 and 2.6-3) (LANL 2001, 071473). Dioxins, explosive compounds, perchlorate, PCBs, and furans will not be analyzed because they are not related to historical operations at TA-51.

4.3 AOC 54-007(d)

The proposed sampling locations for AOC 54-007(d) are the same locations from the 2001 VCA and one additional location beneath the former outlet connection (Figure 4.3-1) to determine nature and extent of potential contaminants not previously analyzed for or that were detected in previous samples. Table 4.3-1 provides a summary of the proposed sampling locations, depths, the objectives each sample addresses, and the analytical suites. Sampling at AOC 54-007(d) will consist of the following activities:

- *Drainlines*. The septic system drainlines were plugged during the 2001 VCA. Samples will be collected from the 0- to 1.0-ft- and 2.0- to 3.0-ft-depth intervals beneath the former inlet and outlet drainline connections to the septic tank. These former septic tank connections are the most likely location for a drainline leak to have occurred. Zero depth is defined as the soil directly beneath the drainlines at a depth of 5.25 ft bgs.
- *Septic Tank*. Samples will be collected from three locations within the septic tank footprint from two depth intervals (10.5 to 11.5 ft bgs and 12.5 to 13.5 ft bgs) at each location.
- *Drain field*. A total of 24 samples will be collected from 12 locations in trenches to be excavated or with hand augers within the drain field at depth intervals of 5.0 to 6.0 ft bgs and 7.0 to 8.0 ft bgs within and beneath the collapsed tiles (Figure 4.3-1).

Samples will be analyzed at off-site fixed laboratories for TAL metals, cyanide, VOCs, SVOCs, nitrate, and isotopic uranium. Strontium-90, isotopic plutonium, gamma spectroscopy, and tritium, will not be analyzed because they were not detected in the septic tank contents and/or VCA confirmation samples (Table 2.6-5) (LANL 2001, 071413). Dioxins, explosive compounds, PCBs/pesticides, perchlorate, and furans will not be analyzed because they are not related to historical operations at facilities in the northeast portion of TA-54 West served by this septic system.

5.0 INVESTIGATION METHODS

Field investigation methods are summarized in Table 5.0-1 and are described in the following sections. The standard operating procedures (SOPs) used to implement these methods are available at http://int.lanl.gov/environment/all/qa.shtml.

5.1 Establish Sampling Locations

The sites proposed for sampling are associated with former structures that have been removed and cannot be visually located. Sample locations will be identified with respect to the former structure locations using engineering drawings. The coordinates of sampling locations will be identified from these drawings. Sample locations will be identified in the field from these coordinates using a global positioning system in accordance with SOP ENV-WQH-SOP-068.

5.2 Sampling

Soil and tuff samples will be collected using the spade-and-scoop (SOP-06.09) or hand-auger (SOP-06.10) methods. Samples that are too deep to collect using a hand auger will be collected using a hollow-stem auger drill rig and split-spoon sampler (SOP-06.24).

Sample paperwork (sample collection logs, container labels, chain-of-custody forms, and custody seals) and sample containers will be obtained through the Sample Management Office (SMO). The SMO will provide the appropriate number, type, and size of containers based on the type of samples and analyses required.

Samples will be field screened for radioactivity and VOCs for health and safety purposes as they are collected. VOC screening will be performed using a headspace screening method in accordance with SOP-06.33. A photoionization detector (PID) with an 11.7-eV lamp will be used to screen for VOCs in pore gas.

Samples will be screened in the field for alpha and beta-gamma radiation using field survey instruments (e.g., Ludlum 130 for alpha and Eberline ESP-1 for beta-gamma). Radiation surveys will be performed by radiological control technicians from the Laboratory's Health Physics Operations Group (RP-1) using RP-1 procedures.

Screening of soil and tuff samples from AOCs 18-005(b) and 18-005(c) for the explosives TNT and RDX will be conducted using D-TECH immunoassay test kits. These semiquantitative field-screening methods will be used to guide characterization and confirmation sampling activities. The field-analytical methods for TNT and RDX are EPA SW-486 (Update III) Methods 4050 and 4051, respectively (EPA 1997, 057589). The detection limits for TNT and RDX using these methods are approximately 1.0 mg/kg.

All pertinent information regarding each sample will be recorded on sample collection logs provided by the SMO, in accordance with EP-Environment Remediation and Support Services (EP-ERSS) SOP-5058.

Field screening data for borehole samples will also be recorded on borehole logs in accordance with SOP-12.01. Samples will be maintained under chain of custody (EP-ERSS-SOP-5058) and preserved according to the requirements for each sample type and analysis (SOP-ENV-DO-206-R0) until they are delivered to the SMO for processing.

All samples (surface and subsurface) will be shipped for analysis through the SMO to off-site fixed laboratories on the EP–ERSS–approved suppliers' list. All samples will be collected and handled according to SOP-ENV-DO-207-R0. The analytical suites for each sampling location are described in the sections pertaining to the individual sites and are listed in the corresponding proposed soil sampling tables. Chemical analyses will be performed in accordance with the analytical statement of work (LANL 2000, 071233). Accredited contract laboratories will use the most recent EPA- and industry-accepted extraction and analytical methods for chemical analyses for analytical suites.

Quality assurance/quality control samples will include field duplicates, equipment blanks, and field trip blanks for VOC analysis. These samples will be collected in accordance with SOP-01.05. Field duplicate samples will be collected at a frequency of at least 1 for every 10 regular samples as directed by the SOP.

5.3 Equipment Decontamination

Sampling equipment will be decontaminated after each sample is collected. Residual material adhering to the equipment will be removed using dry decontamination methods, including wire-brushing and scraping (SOP-01.08). Dry decontamination of sampling equipment may include use of a nonphosphate detergent such as Fantastik on a paper towel and the equipment is wiped, no liquid waste is generated.

5.4 Waste Management

Investigation-derived wastes (IDW) may include personal protective equipment, disposable sampling equipment, and drill cuttings. IDW will be managed in accordance with EP-ERSS-SOP-5022 and the IDW management plan presented in Appendix B.

6.0 MONITORING AND SAMPLING PLAN

MDA H (SWMU 54-004) and MDA L (SWMU 54-006) have ongoing subsurface vapor monitoring programs. This monitoring is being conducted as part of corrective action requirements for these units under the Consent Order. These requirements are separate from those for Middle Cañada del Buey Aggregate Area. Long-term monitoring requirements for MDAs H and L will be established as part of the corrective action implementation for these sites under the Consent Order.

No monitoring is ongoing or proposed for any other SWMUs or AOCs in Middle Cañada del Buey Aggregate Area.

7.0 SCHEDULE

The investigation report for Middle Cañada del Buey Aggregate Area will be submitted within 1 yr after approval of this work plan by NMED.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 References

The following list includes all documents cited in this work plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

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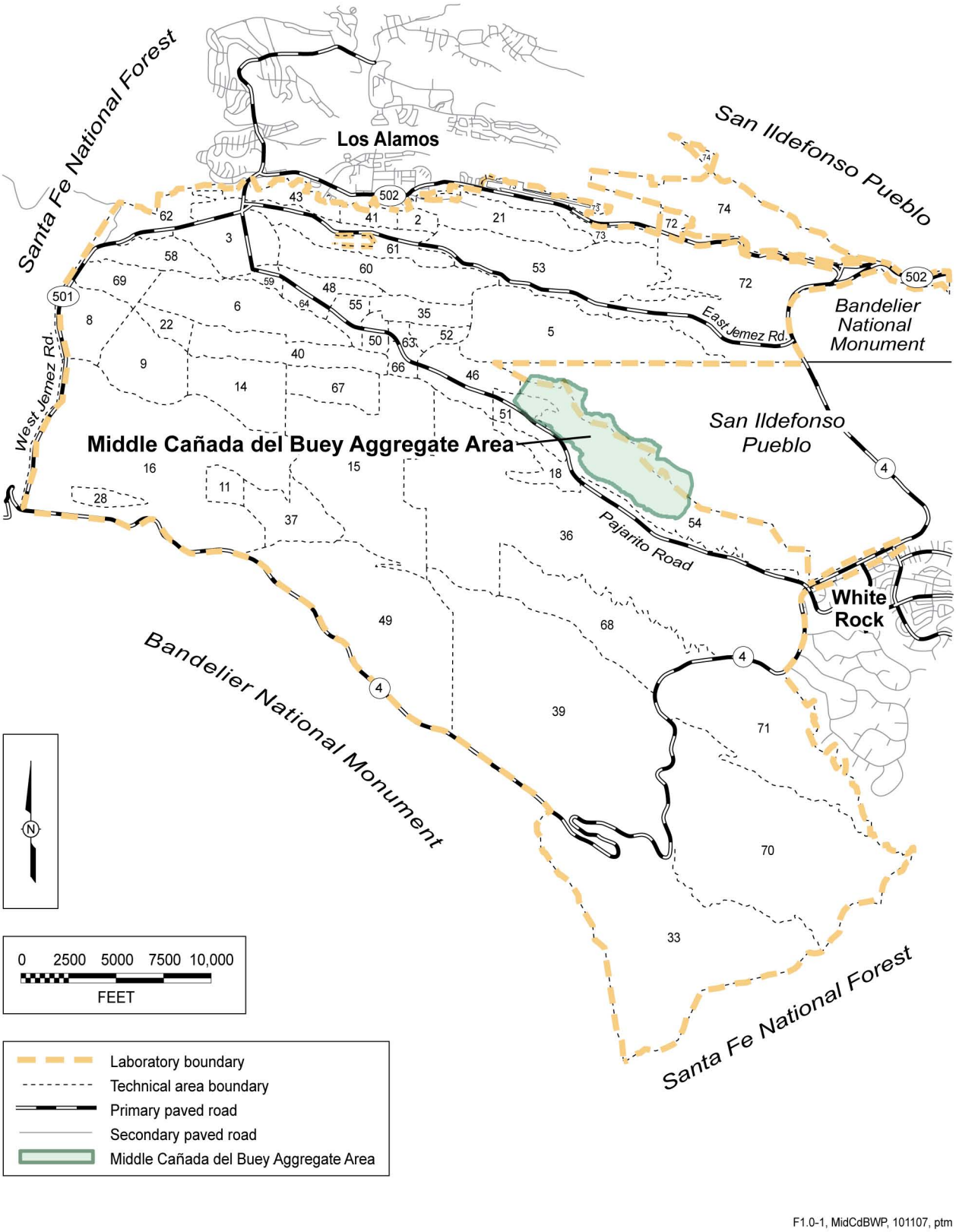


Figure 1.0-1 Middle Cañada del Buey Aggregate Area with respect to the Laboratory TAs and surrounding land holdings

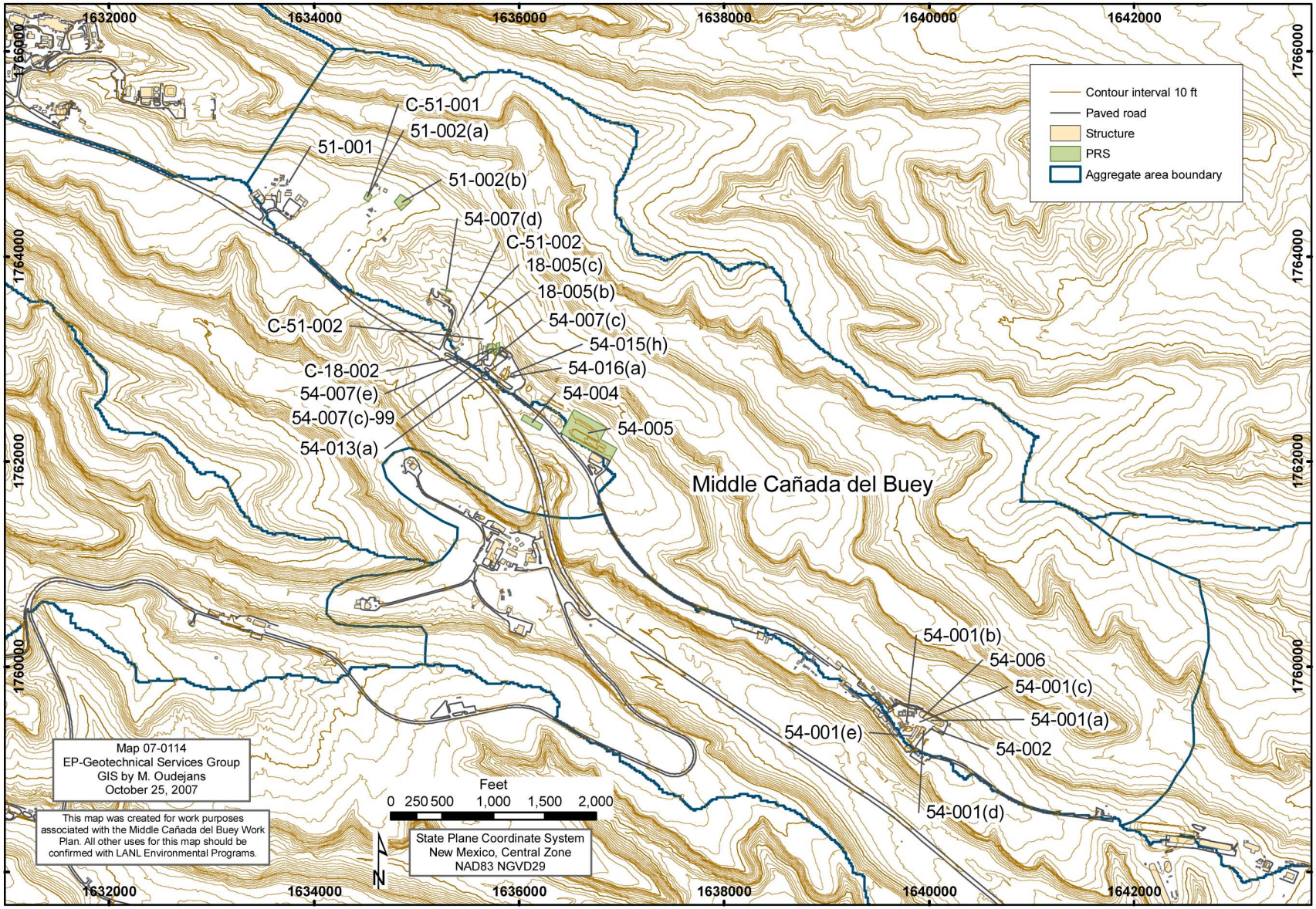


Figure 1.0-2 Sites within the Middle Cañada del Buey Aggregate Area

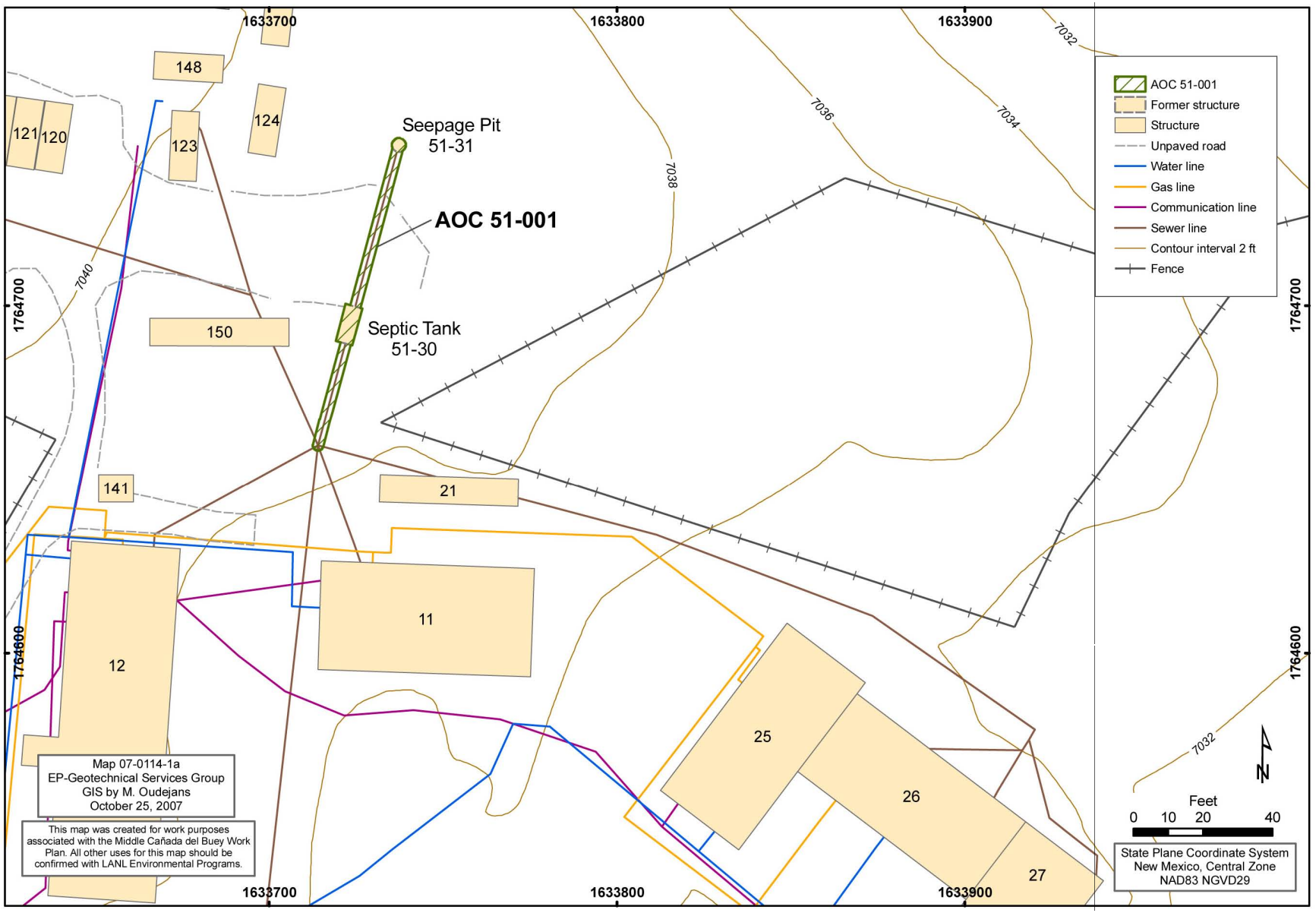


Figure 2.1-1 Location of AOC 51-001

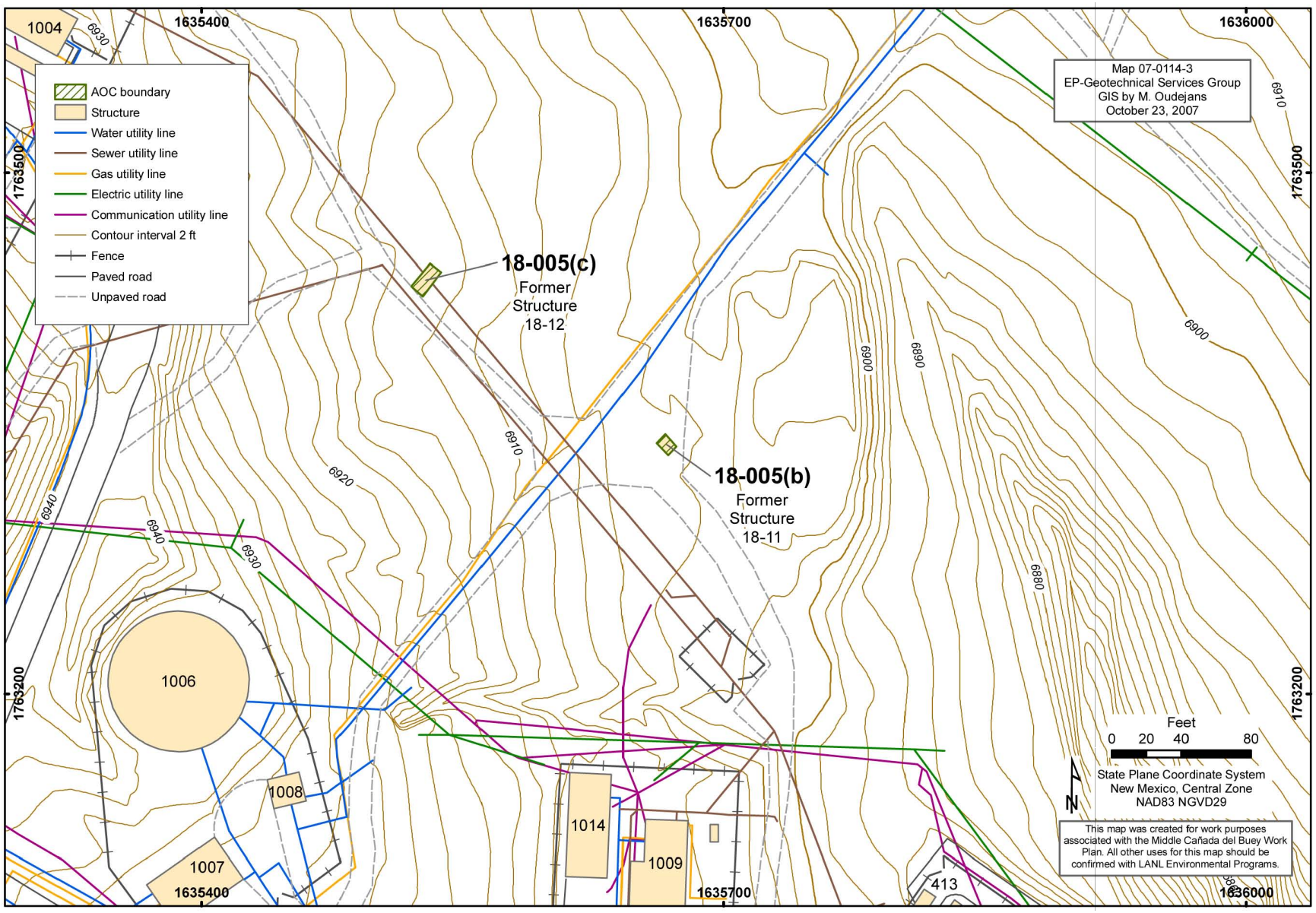


Figure 2.1-2 Locations of AOCs 18-005(b) and 18-005(c)

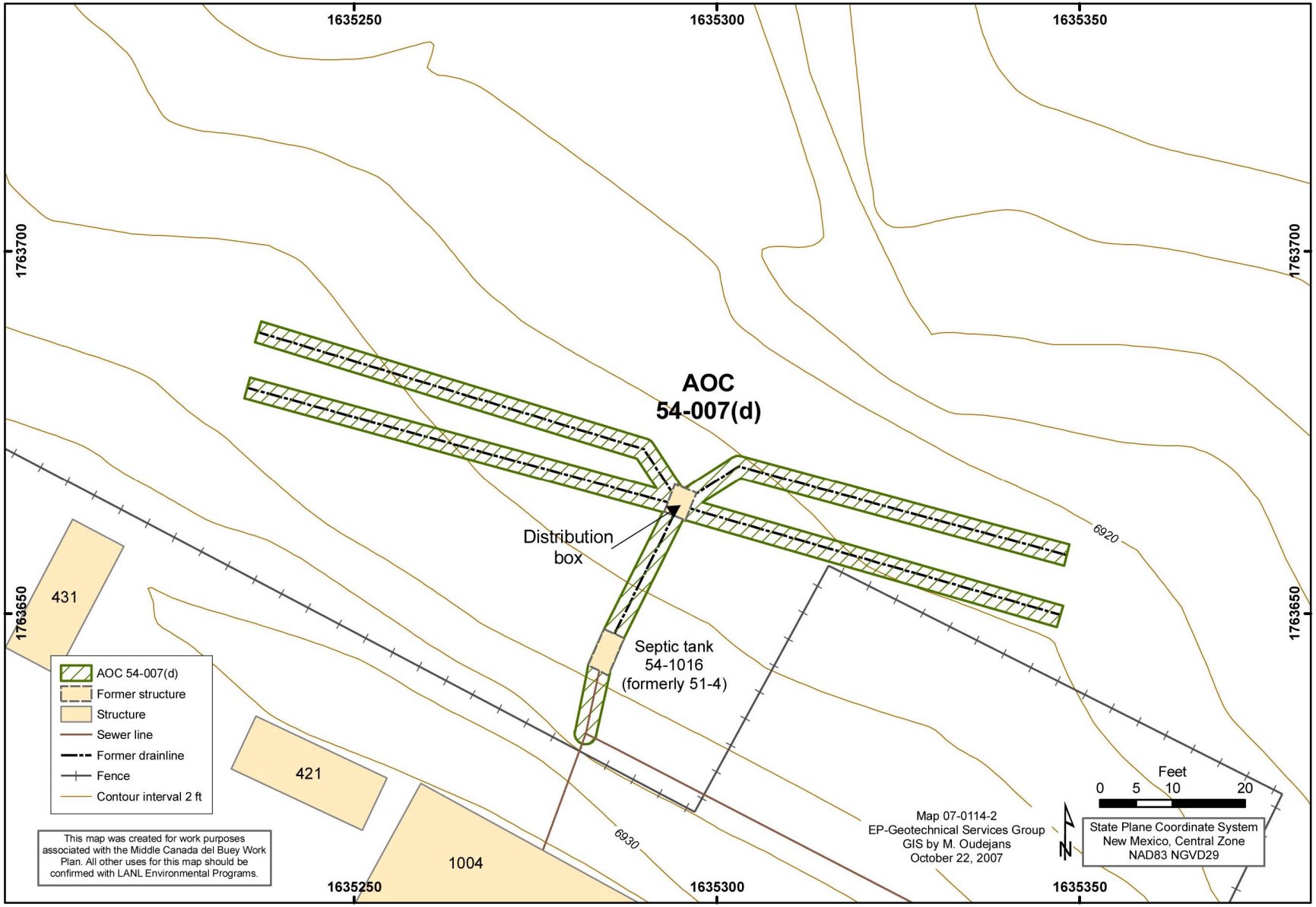


Figure 2.1-3 Location of AOC 54-007(d)

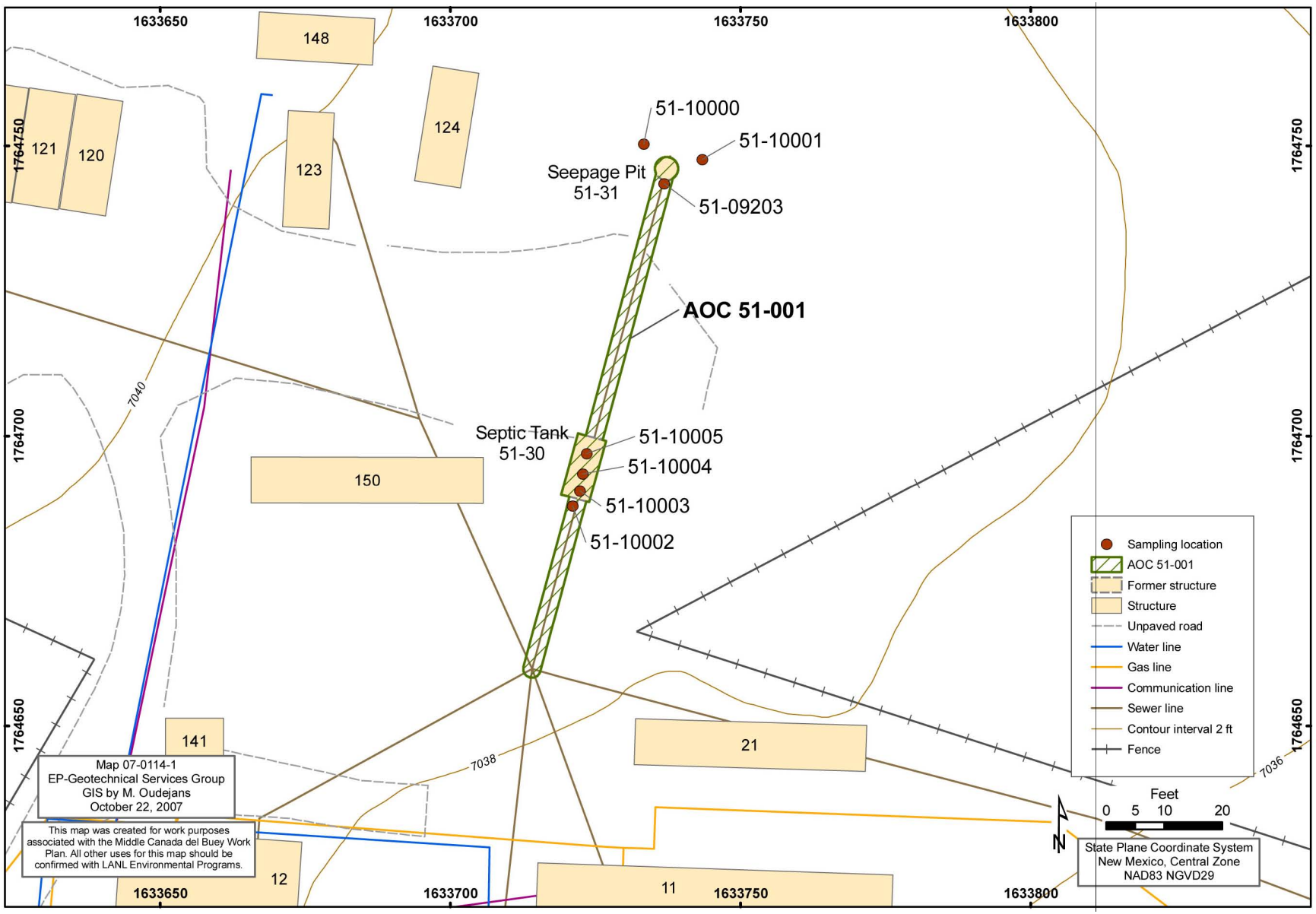


Figure 2.6-1 Historical sampling locations at AOC 51-001

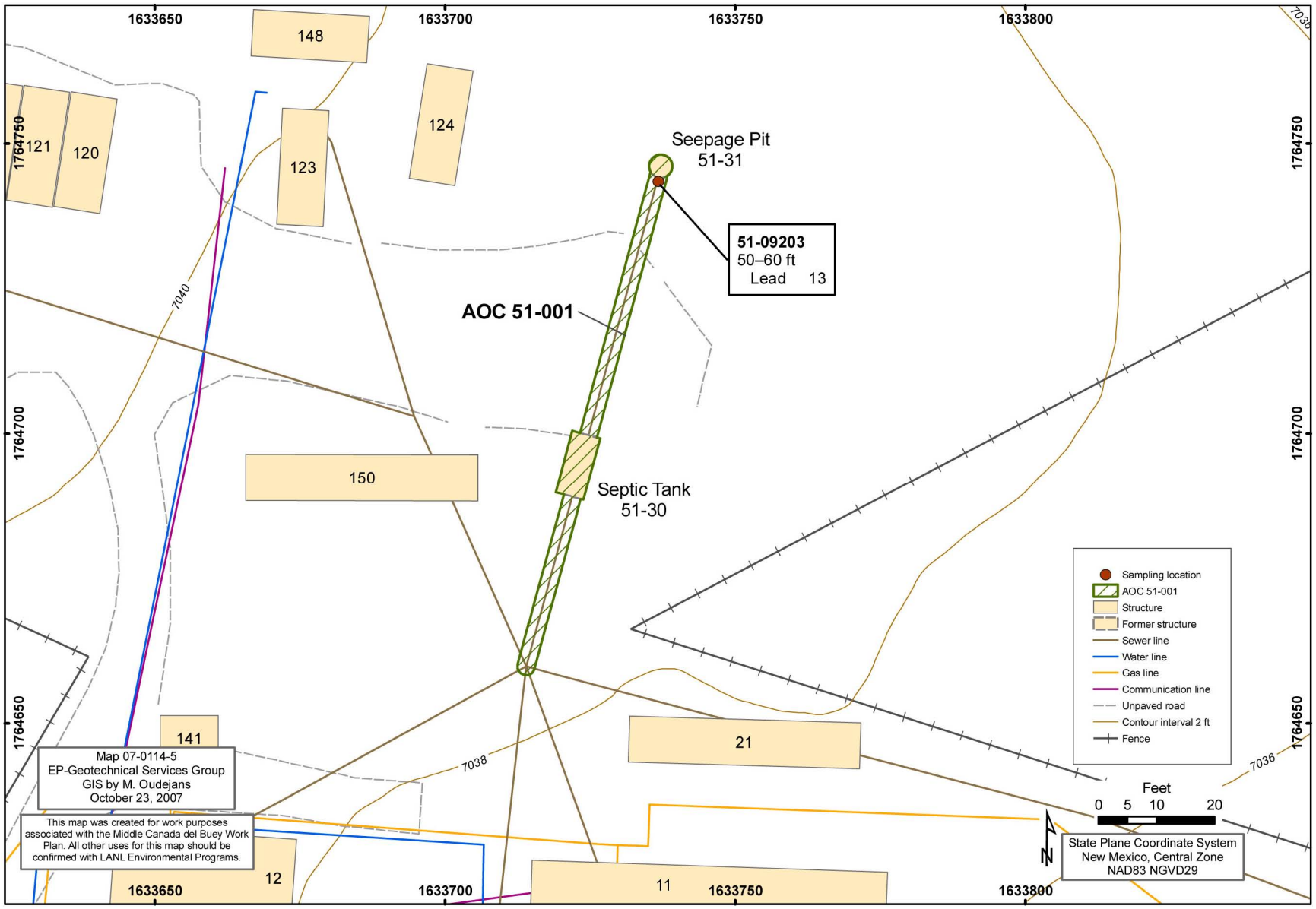


Figure 2.6-2 Inorganic chemicals above BVs at AOC 51-001

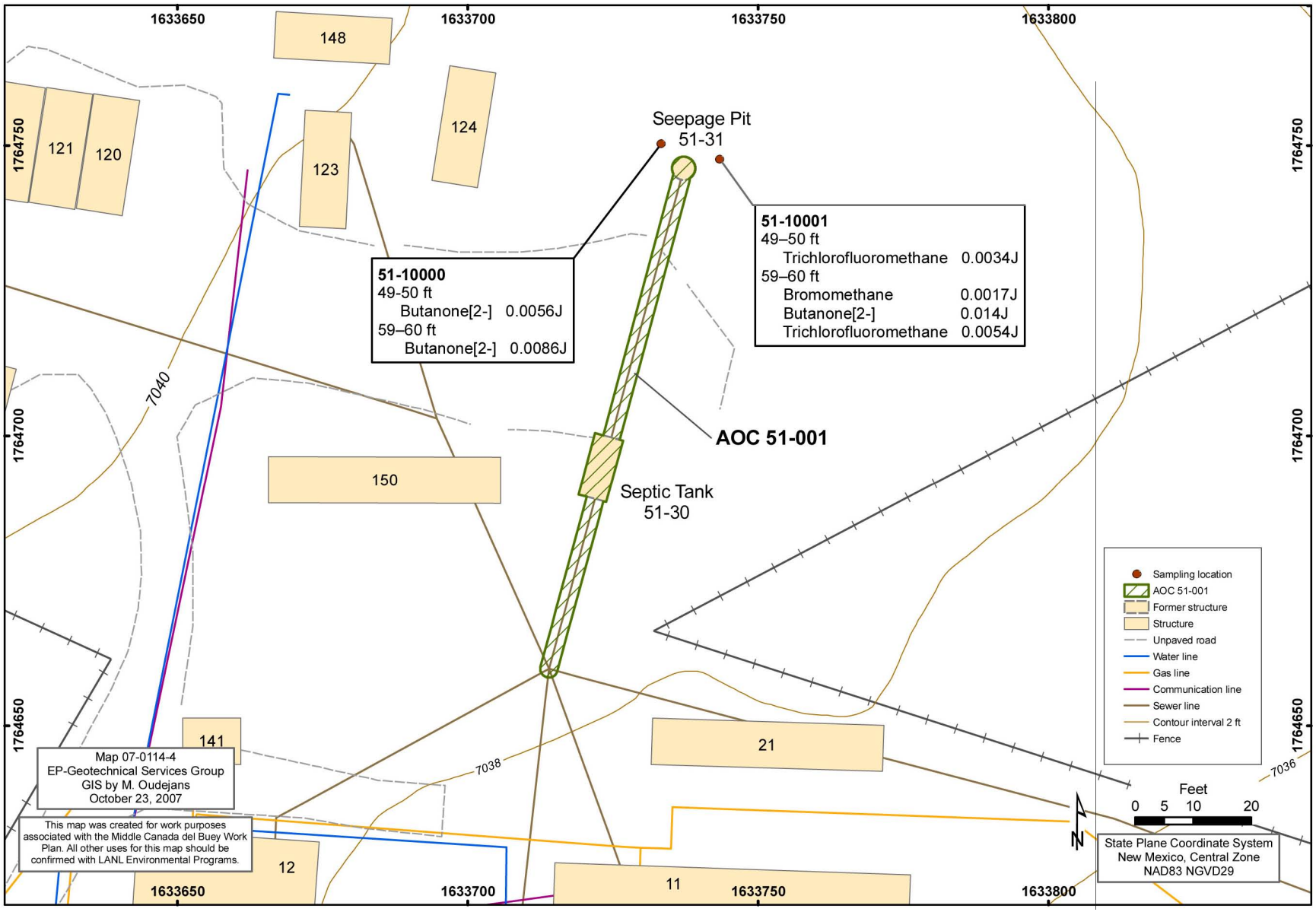


Figure 2.6-3 Organic chemicals detected at AOC 51-001

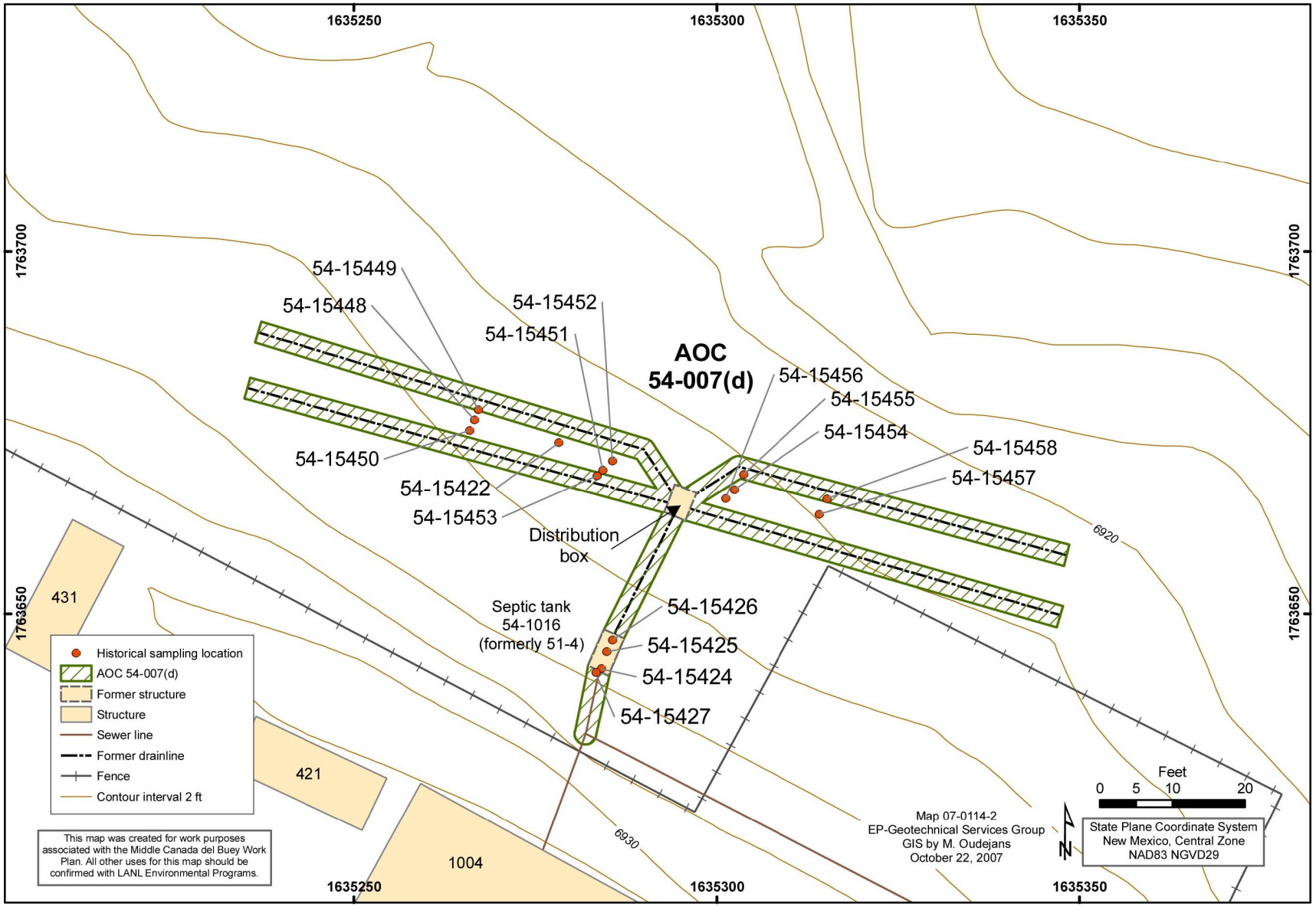


Figure 2.6-4 Historical sampling locations at AOC 54-007(d)

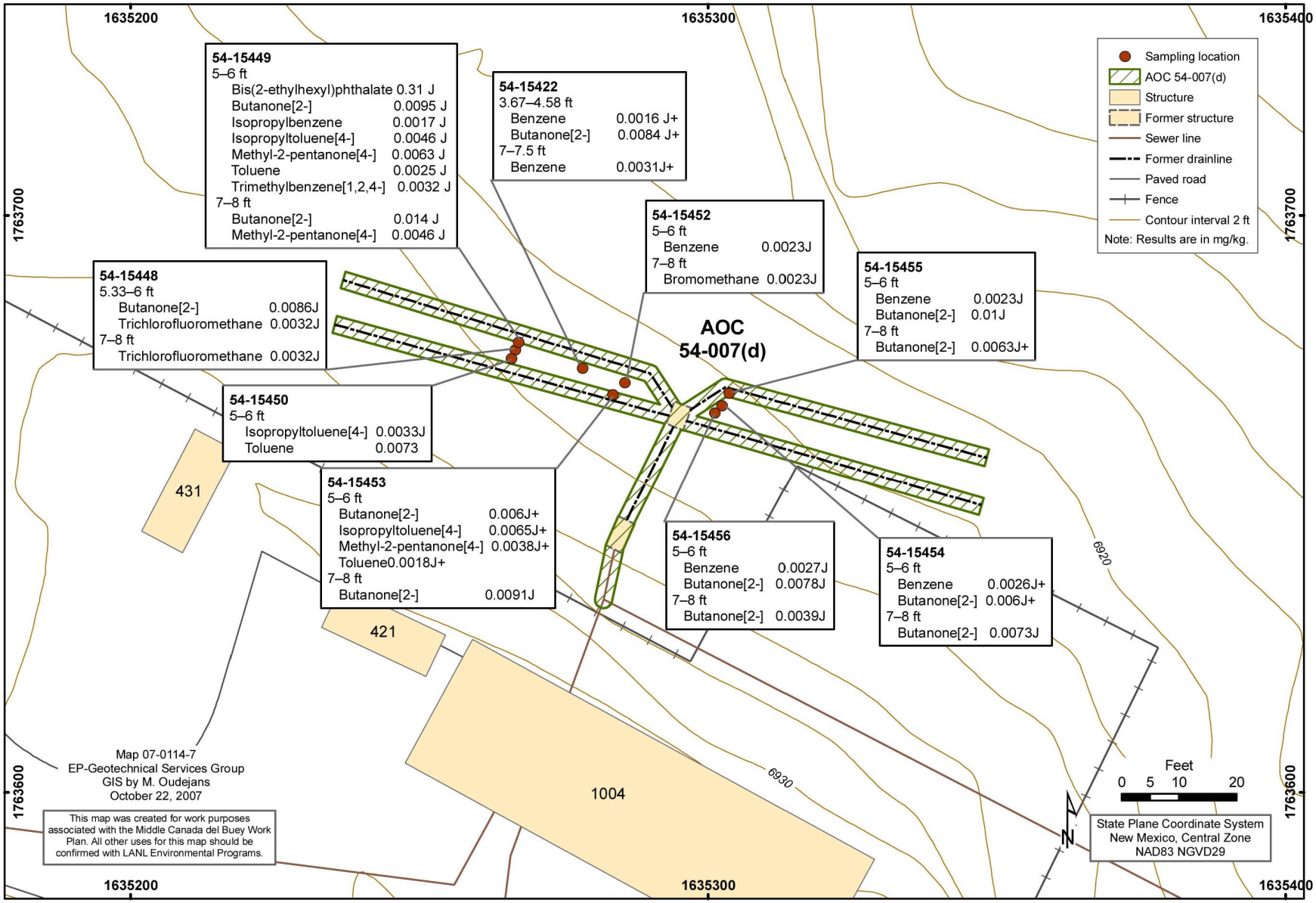


Figure 2.6-5 Organic chemicals detected at AOC 54-007(d)

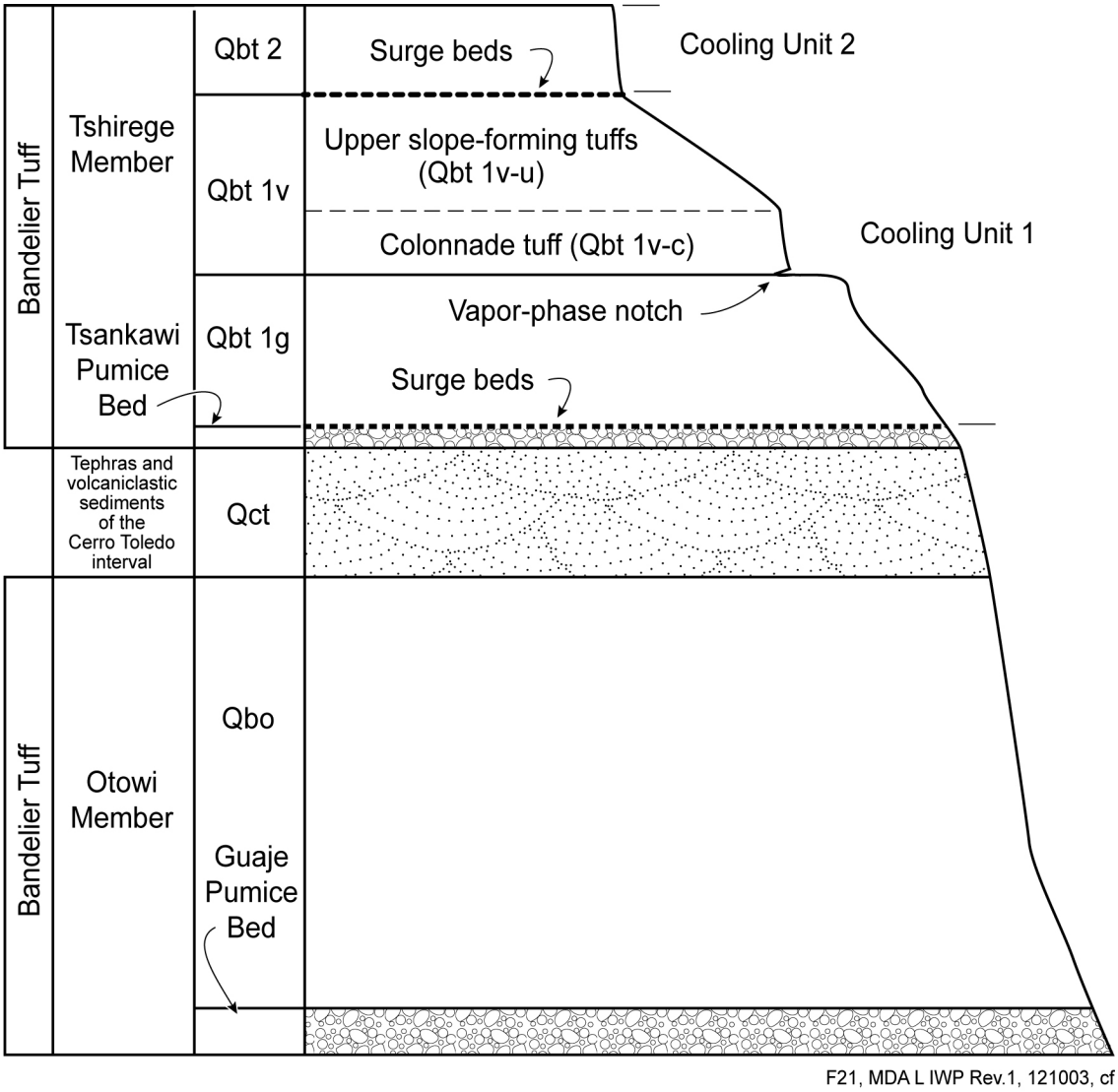
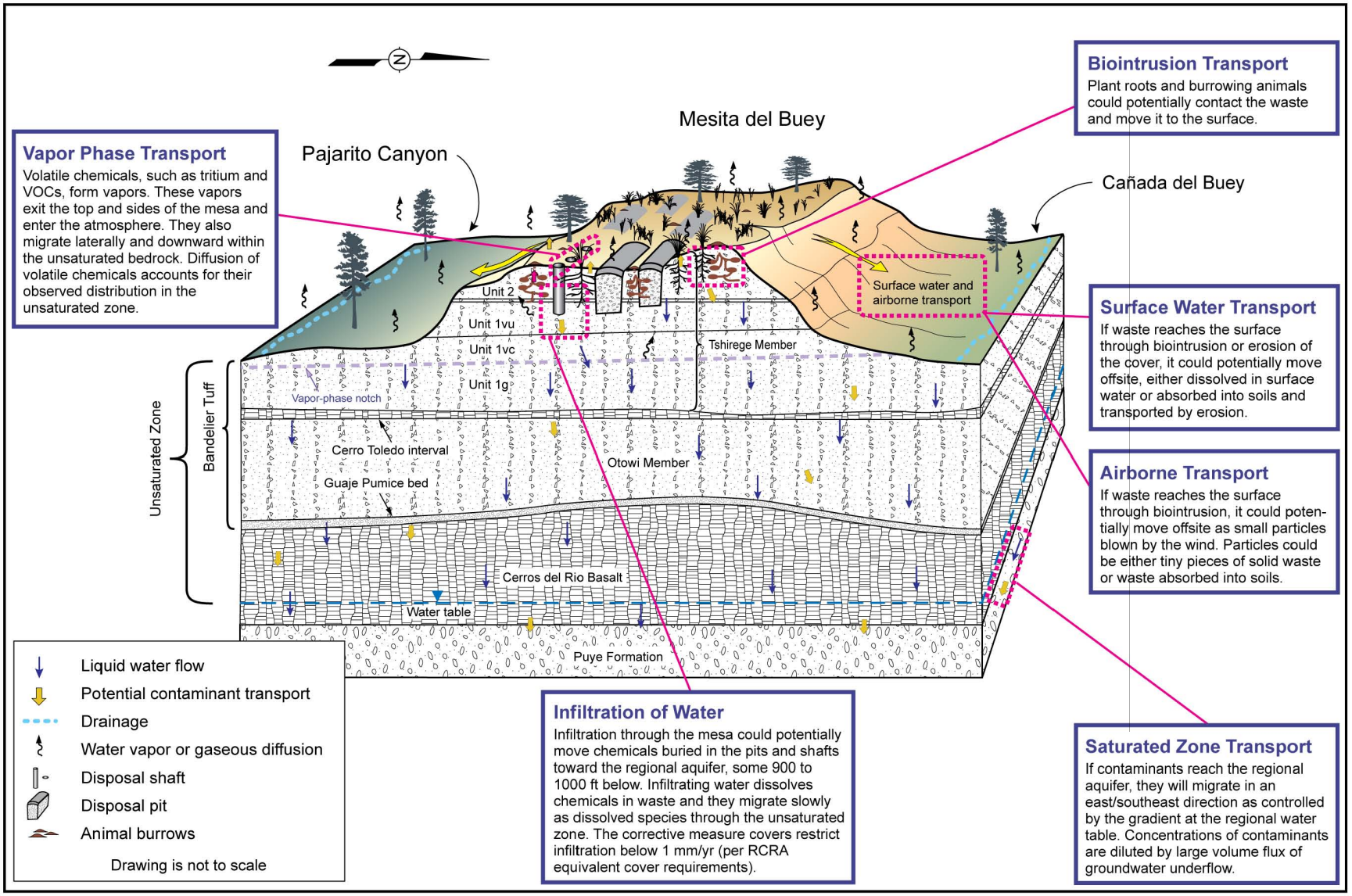


Figure 3.2-1 Generalized stratigraphy of Bandelier Tuff near TA-54



J. Tauxe, 062101 after A. Kron_Rev. for F2.3-1, MDA H RS, 122001, RLM_Rev. for MDA H CMS Rpt., 051403, cf; modified 102207, ptm

Figure 3.2-2 Hydrogeologic conceptual model

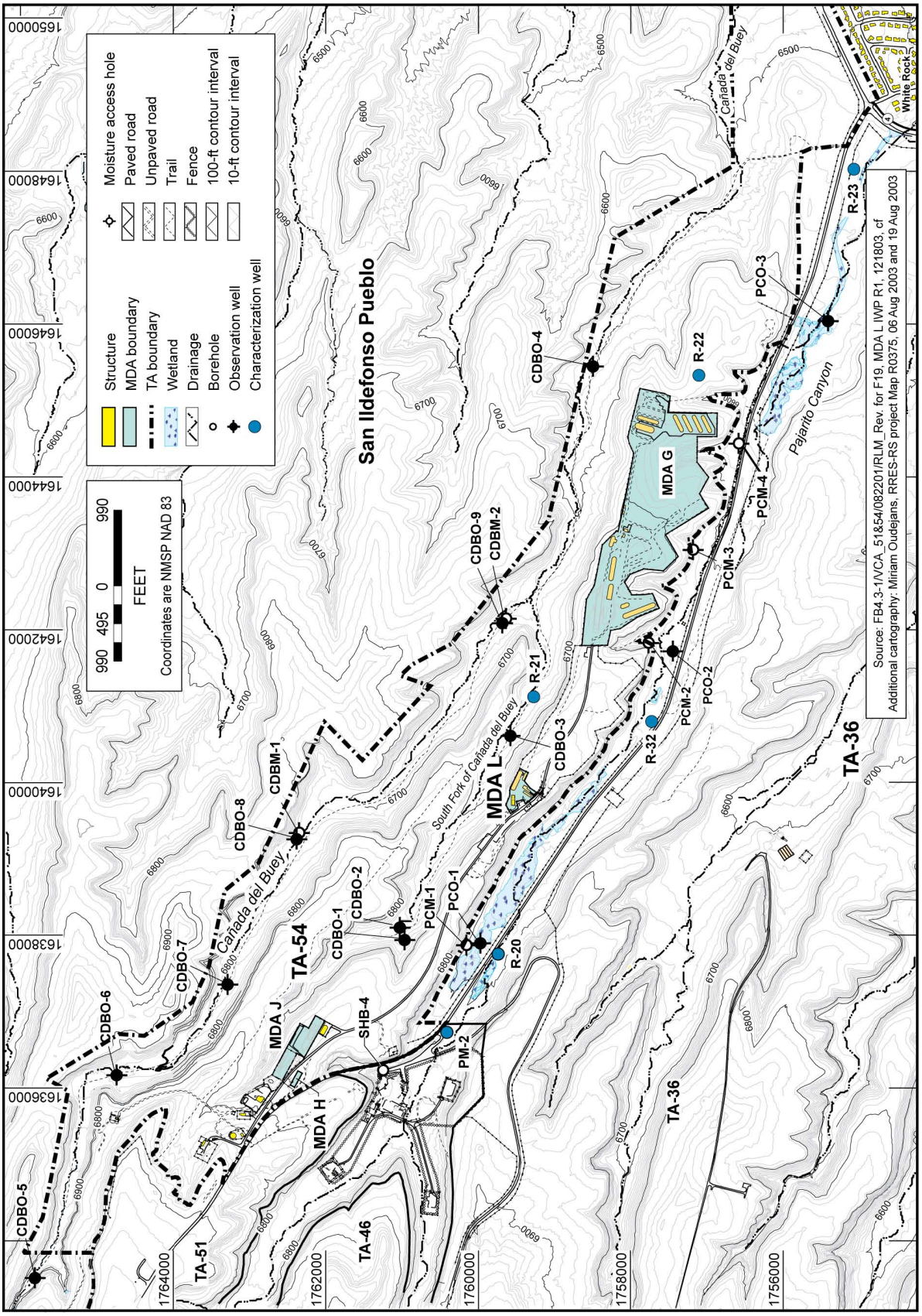
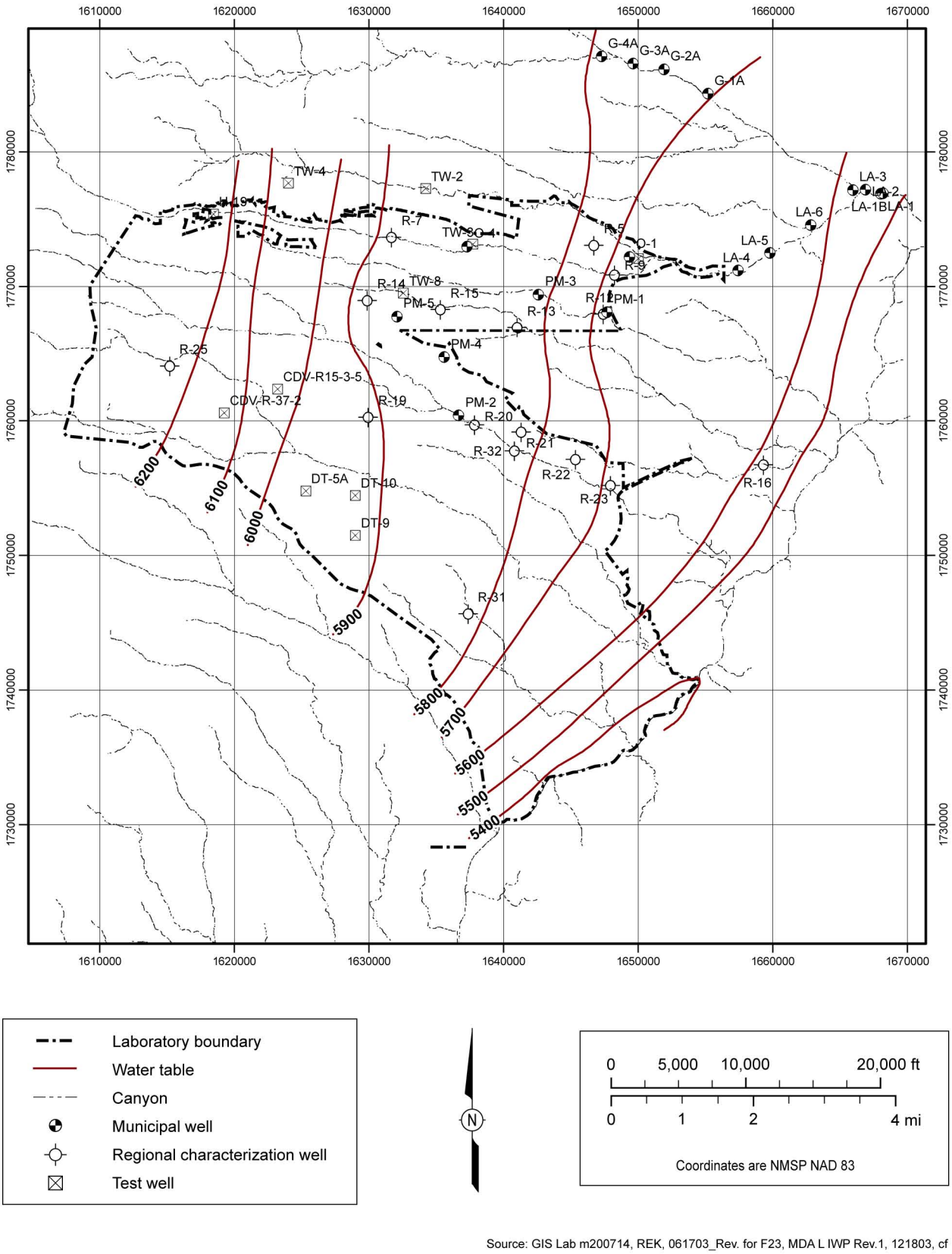


Figure 3.2-3 Locations of wells and boreholes near Middle Cañada del Buey Aggregate Area



Source: GIS Lab m200714, REK, 061703_Rev. for F23, MDA L IWP Rev.1, 121803, cf

Figure 3.2-4 Water table elevations at the Laboratory

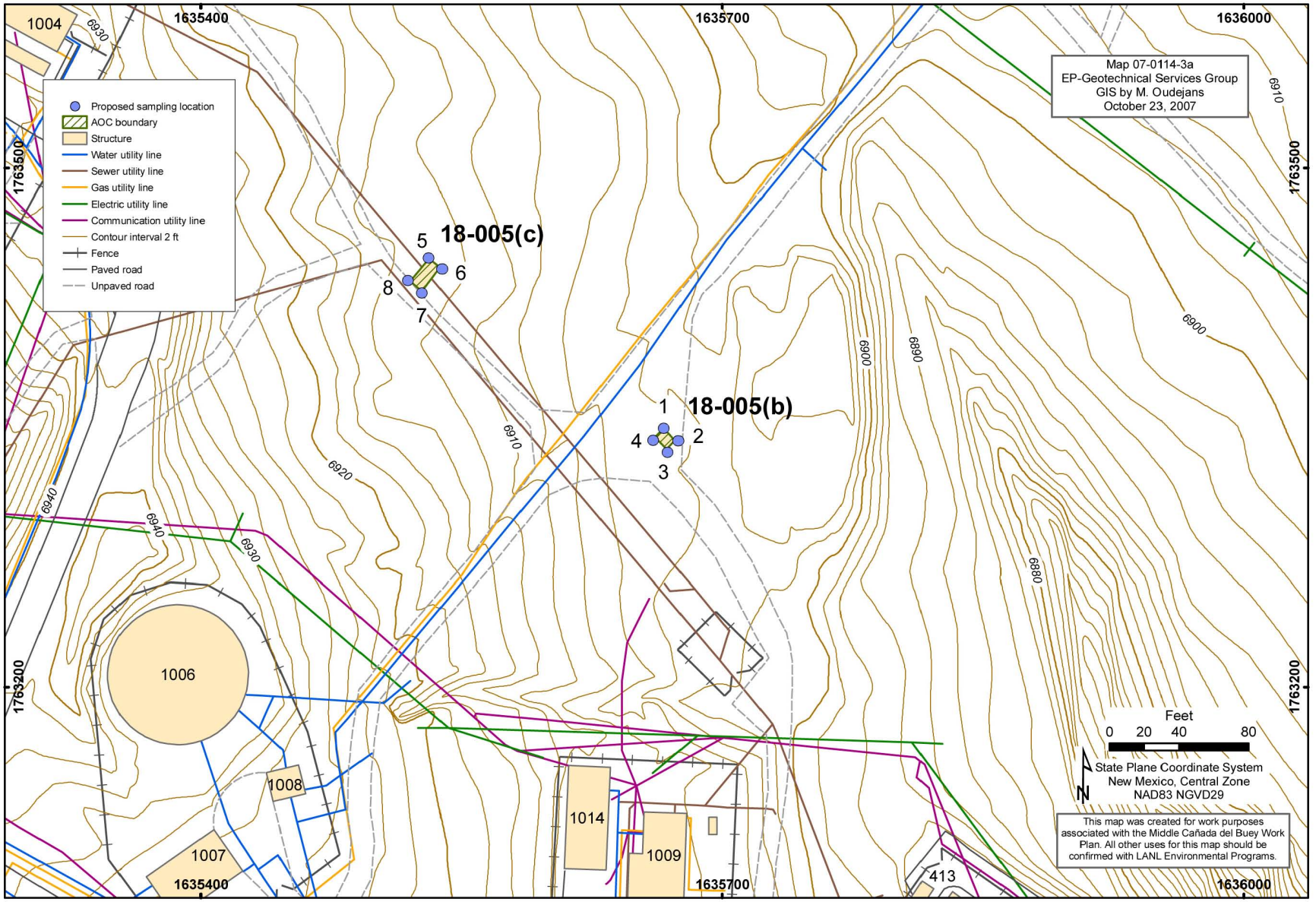


Figure 4.1-1 Proposed sampling locations for AOCs 18-005(b) and 18-005(c)

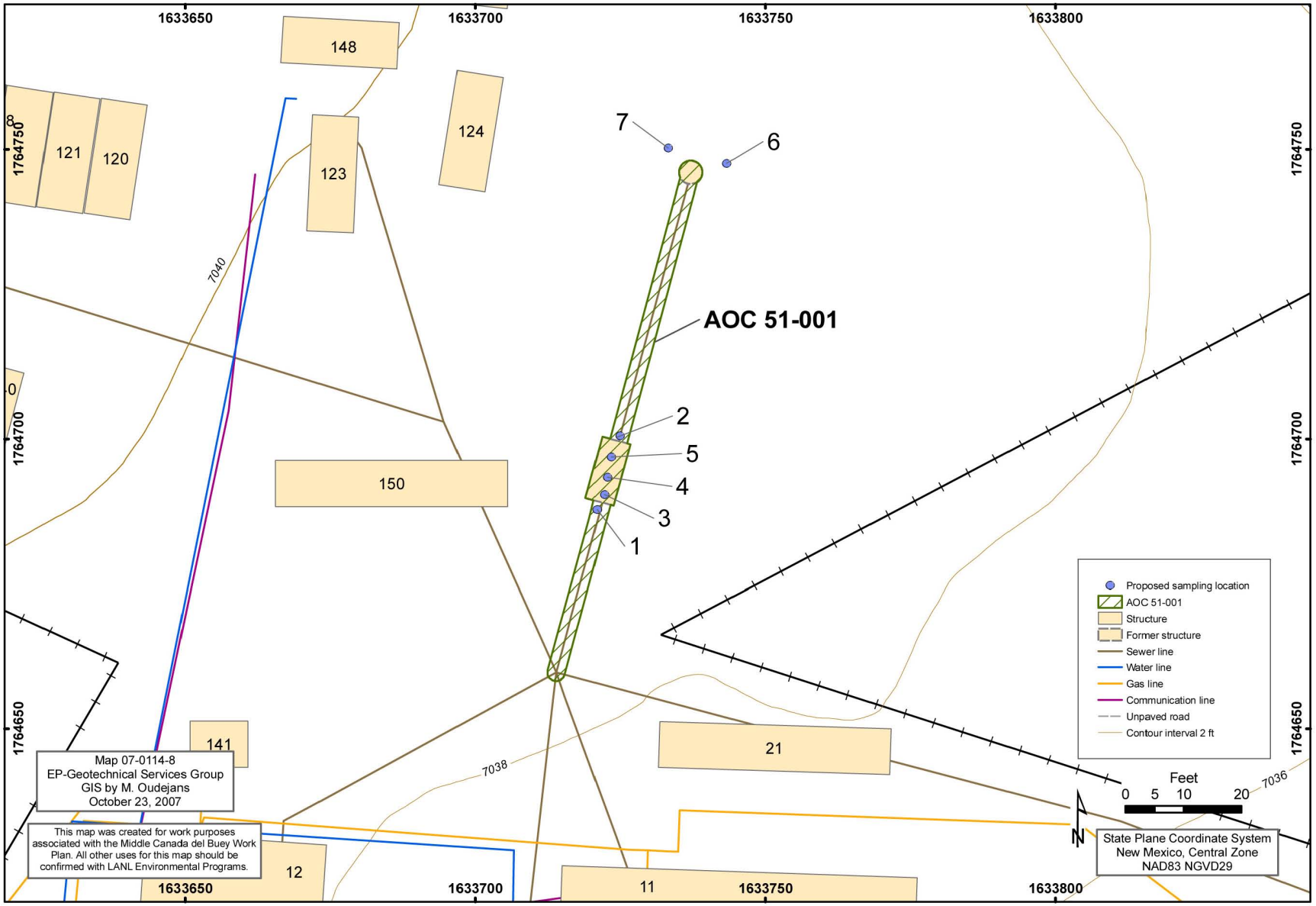


Figure 4.2-1 Proposed sampling locations for AOC 51-001

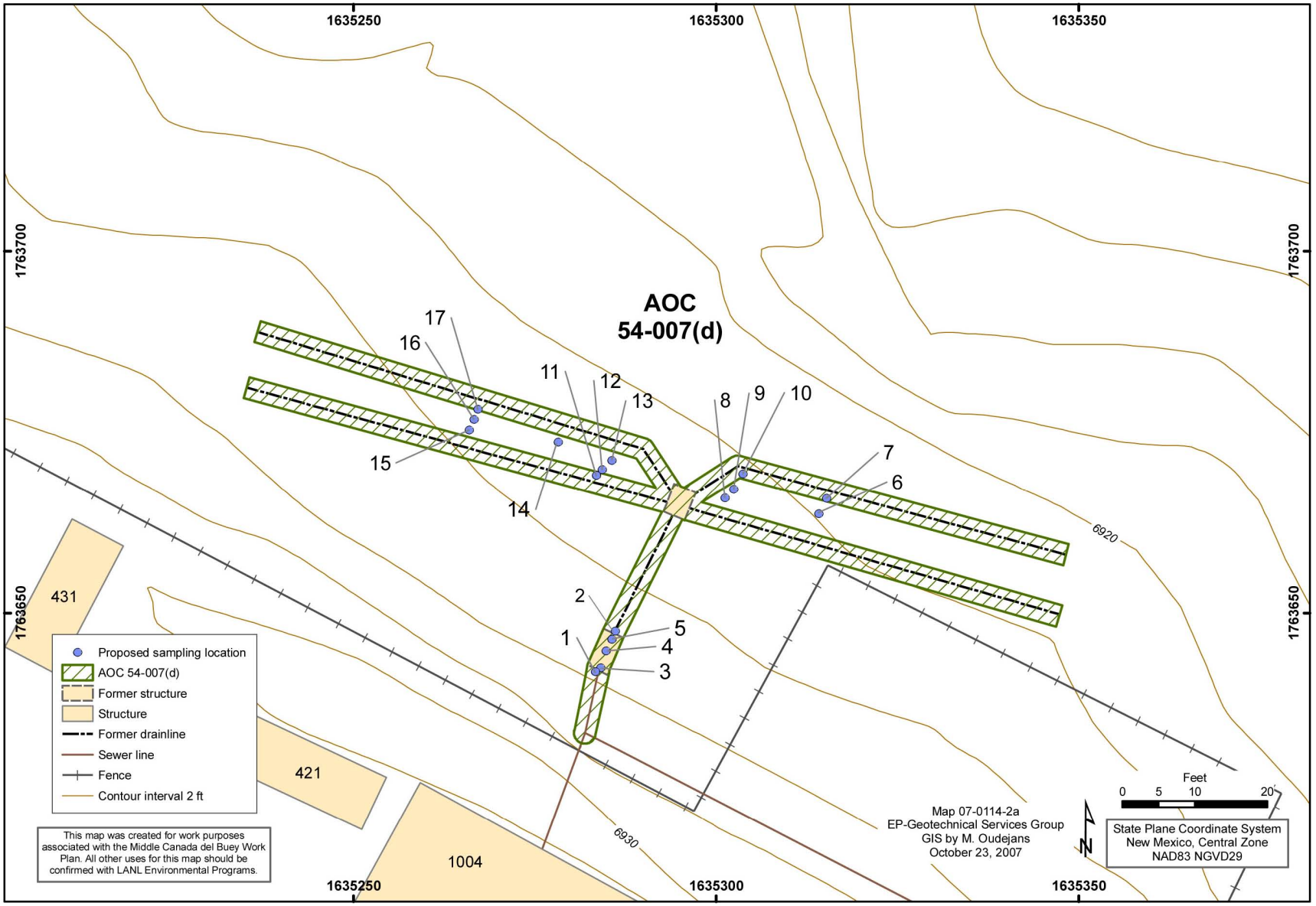


Figure 4.3-1 Proposed sampling locations for AOC 54-007(d)

Table 1.1-1
Summary of SWMUs and AOCs in Middle Cañada del Buey Aggregate Area

Site	Description	Status
Sites To Be Investigated		
AOC 18-005(b)	Former explosive storage magazine	Investigation in progress
AOC 18-005(c)	Former explosive storage magazine	Investigation in progress
AOC 51-001	Former septic system	Investigation in progress
AOC 54-007(d)	Former septic system	Investigation in progress
Sites Previously Approved for NFA		
AOC 51-002(a)	Subsurface environmental research caissons	NFA approved by EPA (2005, 088464)
AOC 51-002(b)	Subsurface environmental research caissons	NFA approved by EPA (2005, 088464)
SWMU 54-001(c)	Former tank storage area	Removed from Module VIII HWFP by NMED (1998, 063042)
SWMU 54-007(c)	Former septic system	Removed from Module VIII HWFP by NMED (2003, 078138)
AOC 54-007(e)	Former septic system	NFA approved by NMED (2002, 071424)
SWMU 54-013(a)	Proposed truck washing pit – never constructed	Removed from Module VIII HWFP by NMED (1998, 063042)
SWMU 54-015(h)	Drum storage area	Removed from Module VIII HWFP by NMED (1998, 063042)
AOC 54-016(a)	Secondary containment sump	NFA approved by EPA (2005, 088464)
AOC C-18-002	Former assembly building	NFA approved by EPA (2005, 088464)
AOC C-51-001	Drum storage area	NFA approved by EPA (2005, 088464)
AOC C-51-002	Former explosive storage magazines	NFA approved by EPA (2005, 088464)
Active Waste Management Units		
SWMU 54-001(a)	Hazardous/mixed waste storage area	RCRA-permitted storage unit
AOC 54-001(b)	Hazardous waste storage area	RCRA-permitted storage unit
AOC 54-001(d)	PCB waste storage area	TSCA-approved storage unit
AOC 54-001(e)	Hazardous waste storage area	RCRA-permitted storage unit
AOC 54-002	Hazardous/mixed waste storage area	RCRA-permitted storage unit
Sites Included in Other Investigations/Programs		
SWMU 54-004	MDA H	Investigation complete(NMED 2003, 075939), corrective measures study ongoing
SWMU 54-005	MDA J	Closed under NMED Solid Waste Regulations (NMED 2003, 098535)
SWMU 54-006	MDA L	Investigation complete (NMED 2007, 098409), corrective measures evaluation ongoing

Table 2.6-1
Summary of Samples Collected and Analyses Requested at AOC 51-001

Sample ID	Location ID	Depth (ft)	Media	Cyanide	METALS	PCBs	Pesticides	SVOCs	VOCs	Gamma Spectroscopy	Gross Alpha/Beta	Tritium	Isotopic Plutonium	Isotopic Uranium	Strontium-90
0551-95-2016	51-09203	50–60	Qbt 3	1685[a]	1685	1684	1684	1684	1684	—[b]	1686	—	—	—	—
MD51-01-0001	51-10000	49–50	Qbt 3	—	—	—	—	8332R	8332R	8334R	—	8334R	8334R	8334R	8334R
MD51-01-0002	51-10000	59–60	Qbt 3	—	—	—	—	8332R	8332R	8334R	—	8334R	8334R	8334R	8334R
MD51-01-0003	51-10001	49–50	Qbt 3	—	—	—	—	8332R	8332R	8334R	—	8334R	8334R	8334R	8334R
MD51-01-0004	51-10001	59–60	Qbt 3	—	—	—	—	8332R	8332R	8334R	—	8334R	8334R	8334R	8334R
MD51-01-0005	51-10002	4.5–5.5	Soil	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R
MD51-01-0006	51-10002	5.5–6.5	Fill	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R
MD51-01-0007	51-10003	11–12	Soil	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R
MD51-01-0008	51-10003	12–13	Qbt 3	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R
MD51-01-0009	51-10004	11–12	Soil	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R
MD51-01-0010	51-10004	12–13	Qbt 3	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R
MD51-01-0011	51-10005	11–12	Fill	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R
MD51-01-0012	51-10005	12–13	Qbt 3	—	—	—	—	8308R	8308R	8310R	—	8310R	8310R	8310R	8310R

[a] Request numbers.

[b] — = Analysis not requested.

Table 2.6-2
Inorganic Chemicals above BV at AOC 51-001

Sample ID	Location ID	Depth (ft)	Media	Antimony	Lead	Mercury	Selenium	Silver
Qbt 2,3,4 BV[a]				**0.5**	**11.2**	**0.1**	**0.3**	**1**
Residential SSL[b]				**31.3**	**400**	**23**[c]	**391**	**391**
Industrial SSL[b]				**454**	**800**	**340**[c]	**5680**	**5680**
0551-95-2016	51-09203	50.0–60.0	Qbt 3	11 (UJ)	13	0.27 (U)	1.1 (U)	2.1 (U)

[a] BVs from LANL 1998, 059730.

[b] SSLs from NMED 2006, 092513, unless otherwise noted.

[c] Value from EPA Region 6 (2007, 095866).

Table 2.6-3
Organic Chemicals Detected at AOC 51-001

Sample ID	Location ID	Depth (ft)	Media	Bromomethane	Butanone[2-]	Trichlorofluoromethane
Residential SSL[a]				**8.51**	**31800**	**390**[b]
Industrial SSL[a]				**32.8**	**48700**	**1300**[b]
MD51-01-0001	51-10000	49.0–50.0	Qbt 3	—[c]	0.0056 (J)	—
MD51-01-0002	51-10000	59.0–60.0	Qbt 3	—	0.0086 (J)	—
MD51-01-0003	51-10001	49.0–50.0	Qbt 3	—	—	0.0034 (J)
MD51-01-0004	51-10001	59.0–60.0	Qbt 3	0.0017 (J)	0.014 (J)	0.0054 (J)

[a] SSLs from NMED 2006, 092513, unless otherwise noted.

[b] Value from EPA Region 6 (2007, 095866)

[c] — = Analyte was not detected.

Table 2.6-4
Summary of Samples Collected
and Analyses Requested at AOC 54-007(d)

Sample ID	Location ID	Depth (ft)	Media	SVOCs	VOCs
MD54-01-0021	54-15422	3.67–4.58	Fill	8201R*	8201R
MD54-01-0022	54-15422	7–7.5	Qbt 3	8201R	8201R
MD54-01-0025	54-15424	10.5–11.5	Soil	8283R	8283R
MD54-01-0026	54-15424	11.5–12.5	Soil	8283R	8283R
MD54-01-0027	54-15425	10.5–11.5	Soil	8283R	8283R
MD54-01-0028	54-15425	11.5–12.5	Soil	8283R	8283R
MD54-01-0029	54-15426	10.5–11.5	Soil	8283R	8283R
MD54-01-0030	54-15426	11.5–12.5	Soil	8283R	8283R
MD54-01-0031	54-15427	5.25–6.25	Soil	8283R	8283R
MD54-01-0032	54-15427	6.25–7.25	Soil	8283R	8283R
MD54-01-0068	54-15448	5.33–6	Fill	8322R	8322R
MD54-01-0069	54-15448	7–8	Soil	8322R	8322R
MD54-01-0070	54-15449	5–6	Fill	8322R	8322R
MD54-01-0071	54-15449	7–8	Fill	8322R	8322R
MD54-01-0072	54-15450	5–6	Fill	8322R	8322R
MD54-01-0073	54-15450	7–8	Fill	8322R	8322R
MD54-01-0074	54-15451	5–6	Fill	8322R	8322R
MD54-01-0075	54-15451	7–8	Fill	8322R	8322R
MD54-01-0076	54-15452	5–6	Fill	8322R	8322R
MD54-01-0077	54-15452	7–8	Fill	8322R	8322R
MD54-01-0078	54-15453	5–6	Fill	8322R	8322R
MD54-01-0079	54-15453	7–8	Fill	8322R	8322R
MD54-01-0080	54-15454	5–6	Fill	8322R	8322R
MD54-01-0081	54-15454	7–8	Fill	8322R	8322R
MD54-01-0082	54-15455	5–6	Fill	8322R	8322R
MD54-01-0083	54-15455	7–8	Fill	8322R	8322R
MD54-01-0084	54-15456	5–6	Fill	8322R	8322R
MD54-01-0085	54-15456	7–8	Fill	8322R	8322R
MD54-01-0086	54-15457	5–6	Fill	8322R	8322R
MD54-01-0087	54-15457	7–8	Fill	8322R	8322R
MD54-01-0088	54-15458	5–6	Fill	8322R	8322R
MD54-01-0089	54-15458	7–8	Fill	8322R	8322R

*Request numbers.

Table 2.6-5
Organic Chemicals Detected at AOC 54-007(d)

Sample ID	Location ID	Depth (ft)	Media	Benzene	Bis(2-ethylhexyl)phthalate	Bromomethane	Butanone[2-]	Isopropylbenzene
Residential SSL[a]				**10.3**	**347**	**8.51**	**31800**	**na**[b]
Industrial SSL[a]				**25.8**	**1370**	**32.8**	**48700**	**na**
MD54-01-0021	54-15422	3.7–4.6	Fill	0.0016 (J+)	—[c]	0.0023 (J+)	0.0084 (J+)	—
MD54-01-0022	54-15422	7.0–7.5	Qbt 3	0.0031 (J+)	—	0.002 (J+)	—	—
MD54-01-0068	54-15448	5.33–6.0	Fill	—	—	—	—	—
MD54-01-0069	54-15448	7.0–8.0	Soil	—	—	—	0.0086 (J)	—
MD54-01-0070	54-15449	5.0–6.0	Fill	—	0.31 (J)	—	0.0095 (J)	0.0017 (J)
MD54-01-0071	54-15449	7.0–8.0	Fill	—	—	—	0.014 (J)	—
MD54-01-0072	54-15450	5.0–6.0	Fill	—	—	—	—	—
MD54-01-0076	54-15452	5.0–6.0	Fill	0.0023 (J)	—	—	—	—
MD54-01-0077	54-15452	7.0–8.0	Fill	—	—	0.0023 (J)	—	—
MD54-01-0078	54-15453	5.0–6.0	Fill	—	—	—	0.006 (J+)	—
MD54-01-0079	54-15453	7.0–8.0	Fill	—	—	—	0.0091 (J)	—
MD54-01-0080	54-15454	5.0–6.0	Fill	0.0026 (J+)	—	—	0.006 (J+)	—
MD54-01-0081	54-15454	7.0–8.0	Fill	—	—	—	0.0073 (J)	—
MD54-01-0082	54-15455	5.0–6.0	Fill	0.0023 (J)	—	—	0.01 (J)	—
MD54-01-0083	54-15455	7.0–8.0	Fill	—	—	—	0.0063 (J+)	—
MD54-01-0084	54-15456	5.0–6.0	Fill	0.0027 (J)	—	—	0.0078 (J)	—
MD54-01-0085	54-15456	7.0–8.0	Fill	—	—	—	0.0039 (J)	—

Table 2.6-5 (continued)

Sample ID	Location ID	Depth (ft)	Media	Isopropyltoluene[4-]	Methyl-2-pentanone[4-]	Toluene	Trichlorofluoromethane	Trimethylbenzene[1,2,4-]
Residential SSL[a]				**na**	**5510**	**252**	**390[d]**	**58.0**
Industrial SSL[a]				**na**	**7010**	**252**	**1300[d]**	**213**
MD54-01-0021	54-15422	3.7–4.6	Fill	—	—	—	—	—
MD54-01-0022	54-15422	7.0–7.5	Qbt 3	—	—	—	—	—
MD54-01-0068	54-15448	5.33–6.0	Fill	—	—	—	0.0032 (J)	—
MD54-01-0069	54-15448	7.0–8.0	Soil	—	—	—	0.0032 (J)	—
MD54-01-0070	54-15449	5.0–6.0	Fill	0.0046 (J)	0.0063 (J)	0.0025 (J)	—	0.0032 (J)
MD54-01-0071	54-15449	7.0–8.0	Fill	—	0.0046 (J)	—	—	—
MD54-01-0072	54-15450	5.0–6.0	Fill	0.0033 (J)	—	0.0073	—	—
MD54-01-0076	54-15452	5.0–6.0	Fill	—	—	—	—	—
MD54-01-0077	54-15452	7.0–8.0	Fill	—	—	—	—	—
MD54-01-0078	54-15453	5.0–6.0	Fill	0.0065 (J+)	0.0038 (J+)	0.0018 (J+)	—	—
MD54-01-0079	54-15453	7.0–8.0	Fill	—	—	—	—	—
MD54-01-0080	54-15454	5.0–6.0	Fill	—	—	—	—	—
MD54-01-0081	54-15454	7.0–8.0	Fill	—	—	—	—	—
MD54-01-0082	54-15455	5.0–6.0	Fill	—	—	—	—	—
MD54-01-0083	54-15455	7.0–8.0	Fill	—	—	—	—	—
MD54-01-0084	54-15456	5.0–6.0	Fill	—	—	—	—	—
MD54-01-0085	54-15456	7.0–8.0	Fill	—	—	—	—	—

[a] SSLs from NMED 2006, 092513, unless otherwise noted.

[b] na = Not available.

[c] — = Analyte was not detected.

[d] Value from EPA Region 6 (2007, 095866).

Table 4.1-1
Summary of Proposed Sampling at AOCs 18-005(b) and 18-005(c)

Objective Addressed	Location Number	Location	Sample Depths (ft)	Explosive Compounds	TAL Metals	Cyanide	Nitrates
AOC 18-005(b)							
Determine nature and extent of potential surface and subsurface contamination	1	North side of footprint of former structure	0–1* 2–3	X	X	X	X
Determine nature and extent of potential surface and subsurface contamination	2	East side of footprint of former structure	0–1*	X	X	X	X
Determine nature and extent of potential surface and subsurface contamination	3	South side of footprint of former structure	2–3	X	X	X	X
Determine nature and extent of potential surface and subsurface contamination	4	West side of footprint of former structure	0–1*	X	X	X	X
AOC 18-005(c)							
Determine nature and extent of potential surface and subsurface contamination	5	North side of footprint of former structure	0–1*	X	X	X	X
Determine nature and extent of potential surface and subsurface contamination	6	East side of footprint of former structure	2–3	X	X	X	X
Determine nature and extent of potential surface and subsurface contamination	7	South side of footprint of former structure	0–1*	X	X	X	X
Determine nature and extent of potential surface and subsurface contamination	8	West side of footprint of former structure	2–3	X	X	X	X

*Zero depth is defined as ground surface.

Table 4.2-1
Summary of Proposed Sampling at AOC 51-001

Objective Addressed	Location Number	Location	Sample Depths (ft)	TAL Metals	Cyanide	Nitrate	VOCs	Isotopic Plutonium	Isotopic Uranium
Determine nature and extent of potential subsurface contamination	1	Beneath former inlet drainline/septic tank connection	0–1[a] 2–3	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	2	Beneath former outlet drainline/septic tank connection	0–1[a] 2–3	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	3	Beneath former septic tank	10.5–11.5[b] 12.5–13.5	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	4	Beneath former septic tank	10.5–11.5[b] 12.5–13.5	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	5	Beneath former septic tank	10.5–11.5[b] 12.5–13.5	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	6	7.5 ft northeast from center of seepage pit	49–50[b] 59–60	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	7	7.5 ft northwest from center of seepage pit	49–50[b] 59–60	X	X	X	X	X	X

[a] Zero depth is defined as the bottom of the drainline.

[b] Zero depth is defined as ground surface.

Table 4.3-1
Summary of Proposed Sampling at AOC 54-007(d)

Objective Addressed	Location Number	Location	Sample Depths (ft)	TAL Metals	Cyanide	Nitrate	Isotopic Uranium	VOCs	SVOCs
Determine nature and extent of potential subsurface contamination	1	Beneath former inlet drainline/septic tank connection	0–1[a] 2–3	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	2	Beneath former outlet drainline/septic tank connection	0–1[a] 2–3	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	3	Beneath former septic tank	10.5–11.5[b] 12.5–13.5	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	4	Beneath former septic tank	10.5–11.5[b] 12.5–13.5	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	5	Beneath former septic tank	10.5–11.5[b] 12.5–13.5	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	6	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	7	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	8	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	9	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	10	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	11	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	12	Beneath drain field	5–6[b] 7-8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	13	Beneath drain field	5-6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	14	Beneath drain field	5–6[b] 7-8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	15	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	16	Beneath drain field	5–6[b] 7-8	X	X	X	X	X	X
Determine nature and extent of potential subsurface contamination	17	Beneath drain field	5–6[b] 7–8	X	X	X	X	X	X

[a] Zero depth defined as bottom of drainline.

[b] Zero depth defined as ground surface.

Table 5.0-1
Summary of Investigation Methods

Method	Summary
Spade and Scoop Collection of Soil Samples	This method is typically used to collect shallow (i.e., approximately 0–12 in.) soil or sediment samples. The "spade-and-scoop" method involves digging a hole to the desired depth, as prescribed in the sampling and analysis plan, and collecting a discrete grab sample. The sample is typically placed in a clean, stainless-steel bowl for transfer into various sample containers.
Hand Auger Sampling	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but may in some cases be used for collecting samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4 in. inner diameter [i.d.]), creating a vertical hole which can be advanced to the desired sample depth. When the desired depth is reached, the auger is decontaminated before advancing the hole through the sample depth. The sample material is transferred from the auger bucket to a stainless-steel sampling bowl before filling the various required sample containers.
Split-Spoon Core-Barrel Sampling	In this method, a stainless-steel core barrel (typically 4-in. i.d., 2.5 ft length) is advanced using a powered drilling rig. The core barrel extracts a continuous length of soil and/or rock that can be examined as a unit. The split-spoon core barrel is a cylindrical barrel split lengthwise so that the two halves can be separated to expose the core sample. Once extracted, the section of core is typically screened for radioactivity and organic vapors, photographed, and described in a geologic log. A portion of the core may then be collected as a discrete sample from the desired depth.
Headspace Vapor Screening	Individual soil, rock, or sediment samples may be field screened for VOCs by placing a portion of the sample in a plastic sample bag or in a glass container with a foil-sealed cover. The container is sealed and gently shaken and allowed to equilibrate for 5 min. The sample is then screened by inserting a PID probe into the container and measuring and recording any detected vapors. PIDs must use lamps with voltage of 10.6 eV or higher.
Handling, Packaging, and Shipping of Samples	Field team members seal and label samples before packing and ensure that the sample containers and the containers used for transport are free of external contamination. Field team members package all samples so as to minimize the possibility of breakage during transportation. After all environmental samples are collected, packaged, and preserved, a field team member transports the samples to either the SMO or an SMO-approved radiation-screening laboratory under chain of custody. The SMO arranges for shipping of samples to analytical laboratories. The field team member must inform the SMO and/or the radiation-screening laboratory coordinator when levels of radioactivity are in the action-level or limited-quantity ranges.
Sample Control and Field Documentation	Sample collection, screening, and transport are documented on standard forms generated by the SMO. These forms include sample collection logs, chain-of-custody forms, and sample-container labels. Collection logs are completed at the time of sample collection and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. Chain-of-custody forms are completed and assigned to verify that the samples are not left unattended. Site attributes (e.g., former and proposed soil sample locations, sediment sample locations) are located by using a global positioning system. Horizontal locations will be measured to the nearest 0.5 ft. The survey results for this field event will be presented as part of the investigation report. Sample coordinates will be uploaded into the Environmental Restoration Database.

Table 5.0-1 (continued)

Method	Summary
Field Quality Control Samples	Field quality control samples are collected as directed in the Consent Order as follows: *Field Duplicate*: At a frequency 10%; collected at the same time as a regular sample and submitted for the same analyses. *Equipment Rinsate Blank*: At a frequency of 10%; collected by rinsing sampling equipment with deionized water, which is collected in a sample container and submitted for laboratory analysis. *Trip Blanks*: Required for all field events that include the collection of samples for VOC analysis. Trip blanks containers of certified clean sand that are opened and kept with the other sample containers during the sampling process.
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination is the preferred method to minimize generating liquid waste. Dry decontamination may include the use of a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by use of a commercial cleaning agent (nonacid, waxless cleaners) and paper wipes. Dry decontamination may be followed by wet decontamination if necessary. Wet decontamination may include washing with a nonphosphate detergent and water, followed by a water rinse and a second rinse with deionized water. Alternatively, steam cleaning may be used.
Containers and Preservation of Samples	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on EPA guidance for environmental sampling, preservation, and quality assurance. Specific requirements for each sample are printed on the sample collection logs provided by the SMO (size and type of container (glass, amber glass, polyethylene, preservative, etc.). All samples are preserved by placing them in insulated containers with ice to maintain a temperature of 4°C. Other requirements such as nitric acid or other preservatives may apply to different media or analytical requests.
Management, Characterization, and Storage of Investigation-Derived Waste	IDW is managed, characterized, and stored in accordance with an approved waste characterization strategy form (WCSF) that documents site history, field activities, and the characterization approach for each waste stream managed. Waste characterization shall be adequate to comply with on-site or off-site waste acceptance criteria. All stored IDW will be marked with appropriate signage and labels, as appropriate. Drummed IDW will be stored on pallets to prevent the containers from deterioration. Generators are required to reduce the volume of waste generated as much as technically and economically feasible. Means to store, control, and transport each potential waste type and classification shall be determined before field operations that generate waste begin. A waste storage area shall be established before generating waste. Waste storage areas located in controlled areas of the laboratory shall be controlled as needed to prevent inadvertent addition or management of wastes by unauthorized personnel. Each container of waste generated shall be individually labeled as to waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste shall be segregated by classification and compatibility to prevent cross-contamination. See Appendix B for additional information.

Appendix A

Acronyms and Abbreviations, Glossary,
Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

AOC	area of concern
bgs	below ground surface
BV	background values
COPC	chemicals of potential concern
DOE	Department of Energy (U.S.)
EETF	Experimental Engineering Test Facility
EP	Environmental Programs Directorate
EPA	Environmental Protection Agency (U.S.)
EQL	estimated quantitation limit
ER	Environmental Restoration Project
FV	fallout value
HE	high explosive(s)
HIR	historical investigation report
HWFP	Hazardous Waste Facility Permit
HWA	Hazardous Waste Act (New Mexico)
i.d.	inner diameter
IWD	investigation-derived waste
LANL	Los Alamos National Laboratory
LLW	low-level radioactive waste
MDA	material disposal area
NFA	no further action
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
OU	operable unit
PCB	polychlorinated biphenyl
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
RANT	Radioassay and Nondestructive Testing
RCRA	Resource Conservation and Recovery Act
RDX	research department explosive (also hexahydro-1,3,5-trinitro-1,3,5-triazine)
RFI	RCRA facility investigation
RPF	Records Processing facility
SMO	Sample Management Office
SOP	standard operating procedure

SVOC	semivolatile organic compound
SWMU	solid waste management unit
SWCS	Sanitary Wastewater Consolidation System
TA	technical area
TAL	target analyte list (EPA)
TCLP	toxicity characteristic leaching procedure
TNT	trinitrotoluene-2,4,6
TSCA	Toxic Substances Control Act
VCA	voluntary corrective action
VOC	volatile organic compound
WCSF	waste characterization strategy form

A-2.0 GLOSSARY

aggregate—At the Los Alamos National Laboratory, an area within a *watershed* containing solid waste management units (SWMUs) and/or areas of concern (AOCs), and the media affected or potentially affected by releases from those SWMUs and/or AOCs. Aggregates are designated to promote efficient and effective corrective action activities.

area of concern—(1) A release that may warrant investigation or remediation and is not a solid waste management unit (SWMU). (2) An area at Los Alamos National Laboratory that may have had a release of a hazardous waste or a hazardous constituent but is not a SWMU.

analysis—A critical evaluation, usually made by breaking a subject (either material or intellectual) down into its constituent parts, then describing the parts and their relationship to the whole. Analyses may include physical analysis, chemical analysis, toxicological analysis, and knowledge-of-process determinations.

analyte—The element, nuclide, or ion a chemical analysis seeks to identify and/or quantify; the chemical constituent of interest.

background level—(1) The concentration of a substance in an environmental medium (air, water, or soil) that occurs naturally or is not the result of human activities. (2) In exposure assessment, the concentration of a substance in a defined control area over a fixed period of time before, during, or after a data-gathering operation.

background value (BV)—A statistically derived concentration (i.e., the upper tolerance limit [UTL]) of a chemical used to represent the background data set. If a UTL cannot be derived, either the detection limit or maximum reported value in the background data set is used.

canyon—A stream-cut chasm or gorge, the sides of which are composed of cliffs or a series of cliffs rising from the chasm's bed. Canyons are characteristic of arid or semiarid regions where downcutting by streams greatly exceeds weathering.

chemical—Any naturally occurring or human-made substance characterized by a definite molecular composition.

chemical of potential concern (COPC)—A detected chemical compound or element that has the potential to adversely affect human receptors as a result of its concentration, distribution, and toxicity.

cleanup—A series of actions taken to deal with the release, or threat of a release, of a hazardous substance that could affect humans and/or the environment. The term cleanup is sometimes used interchangeably with the terms remedial action, removal action, or corrective action.

Compliance Order on Consent (Consent Order)—For the Environmental Remediation and Surveillance Program, an enforcement document signed by the New Mexico Environment Department, the U.S. Department of Energy, and the Regents of the University of California on March 1, 2005, which prescribes the requirements for corrective action at Los Alamos National Laboratory. The purposes of the Consent Order are (1) to define the nature and extent of releases of contaminants at, or from, the facility; (2) to identify and evaluate, where needed, alternatives for corrective measures to clean up contaminants in the environment and prevent or mitigate the migration of contaminants at, or from, the facility; and (3) to implement such corrective measures. The Consent Order supersedes the corrective action requirements previously specified in Module VIII of the Laboratory's Hazardous Waste Facility Permit.

Consent Order—See Compliance Order on Consent.

contaminant—(1) Chemicals and radionuclides present in environmental media or on debris above background levels. (2) According to the March 1, 2005, Compliance Order on Consent (Consent Order), any hazardous waste listed or identified as characteristic in 40 Code of Federal Regulations (CFR) 261 (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]); any hazardous constituent listed in 40 CFR 261 Appendix VIII (incorporated by 20.4.1.200 NMAC) or 40 CFR 264 Appendix IX (incorporated by 20.4.1.500 NMAC); any groundwater contaminant listed in the Water Quality Control Commission (WQCC) Regulations at 20.6.3.3103 NMAC; any toxic pollutant listed in the WQCC Regulations at 20.6.2.7 NMAC; explosive compounds; nitrate; and perchlorate. (Note: Under the Consent Order, the term "contaminant" does not include radionuclides or the radioactive portion of mixed waste.)

corrective action—(1) In the Resource Conservation and Recovery Act, an action taken to rectify conditions potentially adverse to human health or the environment. (2) In the quality assurance field, the process of rectifying and preventing nonconformances.

decommissioning—The permanent removal of facilities and their components from service after the discontinued use of structures or buildings that are deemed no longer useful. Decommissioning must take place in accordance with regulatory requirements and applicable environmental policies.

decontamination—The removal of unwanted material from the surface of, or from within, another material.

detect (detection)—An analytical result, as reported by an analytical laboratory, that denotes a chemical or radionuclide to be present in a sample at a given concentration.

detection limit—The minimum concentration that can be determined by a single measurement of an instrument. A detection limit implies a specified statistical confidence that the analytical concentration is greater than zero.

discharge—The accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of hazardous waste into, or on, any land or water.

disposal—The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into, or on, any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.

effluent—Wastewater (treated or untreated) that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

Environmental Restoration (ER) Project—A Los Alamos National Laboratory project established in 1989 as part of a U.S. Department of Energy nationwide program, and precursor of today's Environmental Remediation and Surveillance (ERS) Program. This program is designed (1) to investigate hazardous and/or radioactive materials that may be present in the environment as a result of past Laboratory operations, (2) to determine if the materials currently pose an unacceptable risk to human health or the environment, and (3) to remediate (clean up, stabilize, or restore) those sites where unacceptable risk is still present.

facility—All contiguous land (and structures, other appurtenances, and improvements on the land) used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units. For the purpose of implementing a corrective action, a facility is all the contiguous property that is under the control of the owner or operator seeking a permit under Subtitle C of the Resource Conservation and Recovery Act.

Hazardous and Solid Waste Amendments (HSWA)—Public Law No. 98-616, 98 Stat. 3221, enacted in 1984, which amended the Resource Conservation and Recovery Act of 1976 (42 United States Code § 6901 et seq).

hazardous constituent (hazardous waste constituent)—According to the March 1, 2005, Compliance Order of Consent (Consent Order), any constituent identified in Appendix VIII of Part 261, Title 40 Code of Federal Regulations (CFR) (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]) or any constituent identified in 40 CFR 264, Appendix IX (incorporated by 20.4.1.500 NMAC).

Hazardous Waste Facility Permit—The authorization issued to Los Alamos National Laboratory (the Laboratory) by the New Mexico Environment Department that allows the Laboratory to operate as a hazardous waste treatment, storage, and disposal facility.

HSWA module—See Module VIII.

infiltration—(1) The penetration of water through the ground surface into subsurface soil. (2) The technique of applying large volumes of wastewater to land to penetrate the surface and percolate through the underlying soil.

material disposal area (MDA)—A subset of the solid waste management units at Los Alamos National Laboratory (the Laboratory) that include disposal units such as trenches, pits, and shafts. Historically, various disposal areas (but not all) were designated by the Laboratory as MDAs.

Module VIII—Module VIII of the Los Alamos National Laboratory (the Laboratory) Hazardous Waste Facility Permit. This permit allows the Laboratory to operate as a hazardous-waste treatment, storage, and disposal facility. From 1990 to 2005, Module VIII included requirements from the Hazardous and Solid Waste Amendments. These requirements have been superceded by the March 1, 2005, Compliance Order on Consent (Consent Order).

National Pollutant Discharge Elimination System—The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits to discharge wastewater or storm water, and for imposing and enforcing pretreatment requirements under the Clean Water Act.

no further action—Under the Resource Conservation and Recovery Act, a corrective-action determination whereby, based on evidence or risk, no further investigation or remediation is warranted.

operable units (OUs)—At Los Alamos National Laboratory, 24 areas originally established for administering the Environmental Remediation and Surveillance Program. Set up as groups of potential release sites, the OUs were aggregated according to geographic proximity for the purposes of

planning and conducting Resource Conservation and Recovery Act (RCRA) facility assessments and RCRA facility investigations. As the project matured, it became apparent that there were too many areas to allow efficient communication and to ensure consistency in approach. In 1994, the 24 OUs were reduced to 6 administrative field units.

outfall—A place where effluent is discharged into receiving waters.

permit—An authorization, license, or equivalent control document issued by the U.S. Environmental Protection Agency or an approved state agency to implement the requirements of an environmental regulation.

polychlorinated biphenyls (PCBs)—Any chemical substance limited to the biphenyl molecule that has been chlorinated to varying degrees, or any combination that contains such substances. PCBs are colorless, odorless compounds that are chemically, electrically, and thermally stable and have proven to be toxic to both humans and other animals.

radiation—A stream of particles or electromagnetic waves emitted by atoms and molecules of a radioactive substance as a result of nuclear decay. The particles or waves emitted can consist of neutrons, positrons, alpha particles, beta particles, or gamma radiation.

radioactive material—For purposes of complying with U.S. Department of Transportation regulations, any material having a specific activity (activity per unit mass of the material) greater than 2 nanocuries per gram (nCi/g) and in which the radioactivity is evenly distributed.

radionuclide—Radioactive particle (human-made or natural) with a distinct atomic weight number.

RCRA facility investigation (RFI)—A Resource Conservation and Recovery Act (RCRA) investigation that determines if a release has occurred and characterizes the nature and extent of contamination at a hazardous waste facility. The RFI is generally equivalent to the remedial investigation portion of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

release—Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of hazardous waste or hazardous constituents into the environment.

Resource Conservation and Recovery Act—The Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976 (Public Law [PL] 94-580, as amended by PL 95-609 and PL 96-482, United States Code 6901 et seq.).

sample—A portion of a material (e.g., rock, soil, water, or air), which, alone or in combination with other portions, is expected to be representative of the material or area from which it is taken. Samples are typically either sent to a laboratory for analysis or inspection or are analyzed in the field. When referring to samples of environmental media, the term field sample may be used.

site characterization—Defining the pathways and methods of migration of hazardous waste or constituents, including the media affected; the extent, direction and speed of the contaminants; complicating factors influencing movement; or concentration profiles.

soil—(1) A material that overlies bedrock and has been subject to soil-forming processes. (2) A sample media group that includes naturally occurring and artificial fill materials.

solid waste management unit (SWMU)—(1) Any discernible site at which solid wastes have been placed at any time, whether or not the site use was intended to be the management of solid or hazardous waste. SWMUs include any site at a facility at which solid wastes have been routinely and systematically released. This definition includes regulated sites (i.e., landfills, surface impoundments, waste piles, and land treatment sites), but does not include passive leakage or one-time spills from production areas and sites in which wastes have not been managed (e.g., product storage areas). (2) According to the March 1, 2005, Compliance Order on Consent (Consent Order), any discernible

site at which solid waste has been placed at any time, and from which the New Mexico Environment Department determines there may be a risk of a release of hazardous waste or hazardous waste constituents (hazardous constituents), whether or not the site use was intended to be the management of solid or hazardous waste. Such sites include any area in Los Alamos National Laboratory at which solid wastes have been routinely and systematically released; they do not include one-time spills.

standard operating procedure—A document that details the officially approved method(s) for an operation, analysis, or action, with thoroughly prescribed techniques and steps.

surface sample—A sample taken at a collection depth that is (or was) representative of the medium's surface during the period of investigative interest. A typical depth interval for a surface sample is 0 to 6 in. for mesa-top locations, but may be up to several feet in sediment-deposition areas within canyons.

target analyte—A chemical or parameter, the concentration, mass, or magnitude of which is designed to be quantified by a particular test method.

technical area (TA)—At Los Alamos National Laboratory, an administrative unit of operational organization (e.g., TA-21).

transport (transportation)—(1) The movement of a hazardous waste by air, rail, highway, or water. (2) The movement of a contaminant from a source through a medium to a receptor.

tuff—Consolidated volcanic ash, composed largely of fragments produced by volcanic eruptions.

U.S. Department of Energy—The federal agency that sponsors energy research and regulates nuclear materials for weapons production.

U.S. Environmental Protection Agency (EPA)—The federal agency responsible for enforcing environmental laws. Although state regulatory agencies may be authorized to administer some of this responsibility, EPA retains oversight authority to ensure the protection of human health and the environment.

A-3.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain U.S. Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in)
millimeters (mm)	0.0394	inches (in)
micrometers or microns (µm)	0.0000394	inches (in)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	Acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-4.0 DATA QUALIFIER DEFINITIONS

Qualifier	Explanation
U	The analyte was analyzed for but not detected. Reported value is the sample-specific EQL or detection limit.
J	The reported value should be regarded as estimated.
J+	The reported value should be regarded as estimated and biased high.
J-	The reported value should be regarded as estimated and biased low.
UJ	The analyte was analyzed for but not detected. Reported value is an estimate of the sample-specific quantitation limit or detection limit.
R	The sample results were rejected because of serious deficiencies in the ability to analyze the sample and meet quality control criteria; presence or absence cannot be verified.

Appendix B

Management Plan for Investigation-Derived Waste

B-1.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

This appendix describes how investigation-derived waste (IDW) generated during the investigation of the Middle Cañada del Buey Aggregate Area sites at Los Alamos National Laboratory (the Laboratory) will be managed. IDW is solid waste generated as a result of field-investigation activities and may include, but is not limited to, drill cuttings, purge water, contaminated personal protective equipment (PPE), sampling supplies and plastic, fluids from the decontamination of PPE and sampling equipment, and all other wastes potentially contacting contaminants.

IDW generated during the investigations at these sites will be managed in a way that is protective of human health and the environment, compliant with applicable regulatory requirements, and consistent with the waste-minimization goals of Los Alamos National Laboratory.

Applicable Laboratory standard operating procedures (SOPs) incorporate the requirements of all applicable U.S. Environmental Protection Agency (EPA) and New Mexico Environment Department regulations, U.S. Department of Energy Orders, and Laboratory implementation requirements. EP-ERSS-SOP-5022, Characterization and Management of Environmental Restoration (ER) Project Waste, describes characterization and management requirements for IDW.

This SOP is available at the following: http://int.lanl.gov/environment/all/qa.shtml.

Waste minimization is accomplished by implementing the requirements of the 2006 “Los Alamos National Laboratory Hazardous Waste Minimization Report” (LANL 2006, 096015). The report is updated annually as a requirement of Module VIII of the Laboratory’s Hazardous Waste Facility Permit (EPA 1990, 001585; EPA 1994, 044146).

A waste characterization strategy form (WCSF) will be prepared and approved by Environmental Programs (EP) Directorate personnel per requirements of SOP-EP-ERSS-SOP-5022 before field investigation activities begin. The WCSF will provide detailed information on IDW characterization, management, containerization, and potential volume generation. IDW characterization will be achieved through existing data and/or documentation and through direct sampling of the IDW or of the media being investigated (i.e., surface soil, subsurface soil, sediment, etc.). If waste characterization sampling is necessary, it will be described in the WCSF.

The selection of waste containers will be based on the appropriate U.S. Department of Transportation requirements, waste types, and estimated volumes of IDW to be generated. Immediately following containerization, each waste container will be individually labeled with a unique identification number and with information regarding waste classification, item(s), radioactivity (if applicable), and date generated. If wastes are pending analytical results to make a final characterization determination, the containers will be labeled as such until analytical results are available. The wastes will be contained in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on the type of IDW and its classification. Container and storage requirements will be detailed in the WCSF and approved before the waste is generated.

Transportation and disposal requirements will be detailed in the WCSF and approved before waste is generated. Table B-1.0-1 summarizes how wastes will be managed.

The anticipated waste streams that will be generated and managed during work plan implementation at the Middle Cañada del Buey Aggregate Area investigation sites include the following:

Drill cuttings: The drill cuttings waste stream will consist of cuttings from all boreholes drilled during field activities. Drill cuttings will be collected and containerized at the point of generation (i.e., at the drill rig). The drill cutting waste stream will be characterized with analytical results from core samples, augmented by direct sampling of the containerized waste, if necessary. The maximum detected concentrations of radionuclides will be compared with background values. If maximum concentrations exceed background/fallout values, the waste cuttings will be designated as low-level radioactive waste (LLW). Total concentrations of toxicity characteristic leaching procedure (TCLP) constituents will be compared with 20 times the TCLP regulatory level. If total concentrations are less than 20 times the TCLP regulatory level, the waste cuttings will be designated nonhazardous by characteristic. If total concentrations exceed 20 times the TCLP regulatory level, the waste cuttings will be sampled and analyzed using the TCLP to determine if it is hazardous by characteristic. If potential EPA-listed hazardous waste constituents are detected, the Laboratory will conduct a review of historical records and data to determine whether the source of each constituent was a listed hazardous waste at its point of generation. If the source is determined to be a listed hazardous waste, or if the cuttings are determined to be toxicity characteristic or characteristic hazardous waste, the cuttings will be managed as hazardous or mixed waste (depending on the levels of radioactivity). Otherwise, the cuttings will be managed as nonhazardous solid waste or LLW (depending on the levels of radioactivity). Based on the results of previous investigations, the Laboratory expects these wastes to be designated as nonhazardous, nonradioactive solid waste that will be disposed of at an off-site industrial waste disposal facility.

Spent PPE: The spent PPE waste stream will consist of PPE that has potentially contacted contaminated environmental media (i.e., core and/or drill cuttings) and that cannot be decontaminated. The bulk of this waste stream will consist of protective clothing such as coveralls, gloves, and shoe covers. Spent PPE will be collected in containers at personnel decontamination stations. Characterization of this waste stream will be performed through acceptable knowledge of the waste materials, the methods of generation, and the analytical results from the sampling of the environmental media with which the materials were in contact. The Laboratory expects these wastes to be designated as nonhazardous, nonradioactive solid waste that will be disposed of at an off-site industrial waste disposal facility.

Disposable sampling supplies: The disposable sampling supplies waste stream will consist of all equipment and materials necessary for collecting samples that come into direct contact with contaminated environmental media and that cannot be decontaminated. This waste stream also includes wastes associated with dry decontamination activities and will consist primarily of paper and plastic items collected in bags at the sampling location and transferred to accumulation drums. Characterization of this waste stream will be performed through acceptable knowledge of the waste materials, the methods of generation, and the analytical results from the sampling of the environmental media with which the materials were in contact. The Laboratory expects these wastes to be designated as nonhazardous, nonradioactive solid waste that will be disposed of at an off-site industrial waste disposal facility.

Decontamination fluids: The decontamination fluids waste stream will consist of liquid wastes from decontamination activities (i.e., decontamination solutions and rinse waters). Consistent with waste minimization practices, the Laboratory employs dry decontamination methods to the extent possible. If dry decontamination cannot be performed, liquid decontamination wastes will be collected in containers at the point of generation and characterized with analytical results from direct sampling of the containerized waste. The Laboratory expects these wastes to be designated as nonhazardous, nonradioactive liquid waste that will be sent to an on-site treatment facility with appropriate waste acceptance criteria.

B-2.0 REFERENCES

The following list includes all documents cited in this work plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

EPA (U.S. Environmental Protection Agency), April 10, 1990. "Module VIII of RCRA Permit No. NM0890010515, issued to Los Alamos National Laboratory, Los Alamos, New Mexico," EPA Region VI, Hazardous Waste Management Division, Dallas, Texas. (EPA 1990, 001585)

EPA (U.S. Environmental Protection Agency), April 19, 1994. "Module VIII of RCRA Permit No. NM0890010515, EPA, Region 6, New Requirements Issued to Los Alamos National Laboratory, Los Alamos, New Mexico," EPA Region 6, Hazardous Waste Management Division, Dallas, Texas. (EPA 1994, 044146)

LANL (Los Alamos National Laboratory), November 2006. "Los Alamos National Laboratory Hazardous Waste Minimization Report," Los Alamos National Laboratory document LA-UR-06-8175, Los Alamos, New Mexico. (LANL 2006, 096015)

Table B-1.0-1
Summary of Expected Waste Management

Waste Stream	Expected Waste Type	On-Site Management	Expected Disposition
Drill cuttings	Industrial solid nonhazardous waste	B-25 boxes	Disposal at approved off-site disposal facility
Spent PPE	Industrial solid nonhazardous waste	Accumulation in 55-gal. drum	Disposal at approved off-site disposal facility
Disposable sampling supplies	Industrial solid Nonhazardous waste	Accumulation in 55-gal. drum	Disposal at approved off-site disposal facility